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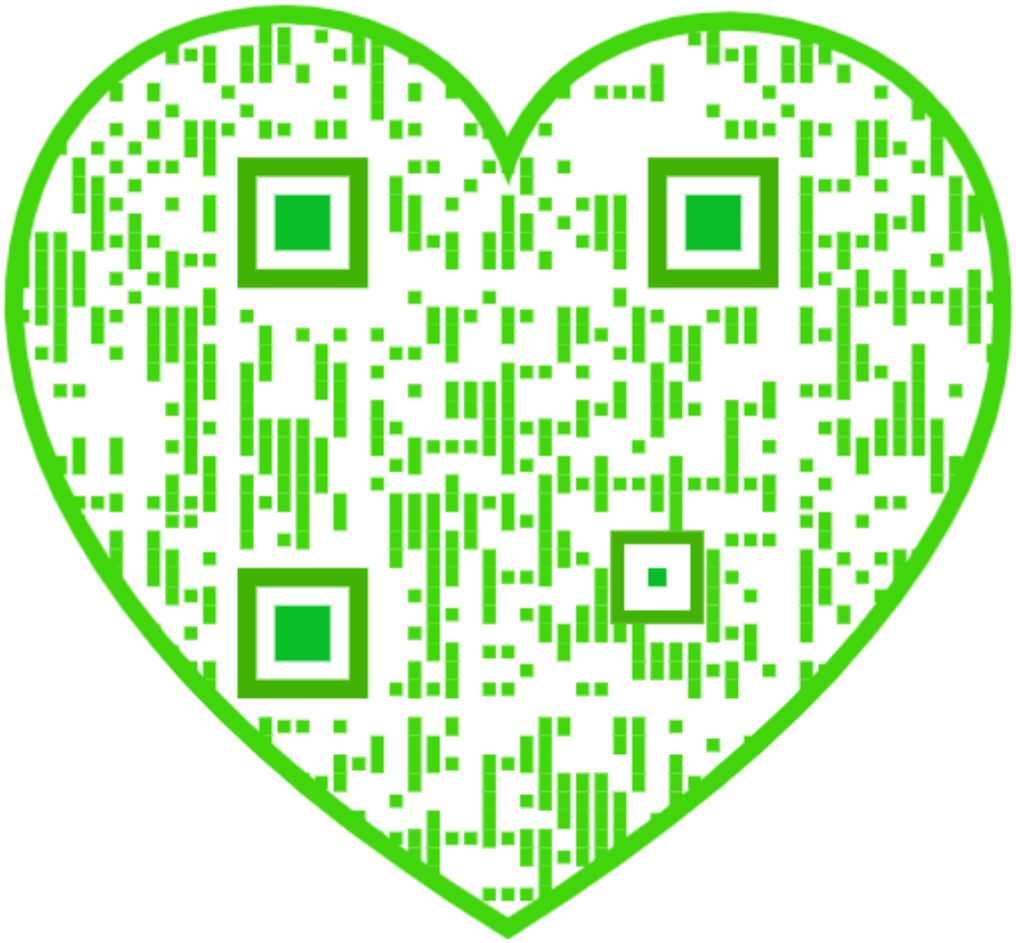

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MUNICIPAL ENGINEERING

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EDITORIAL

MUNICIPAL BOND SALES

The effect of the war upon municipal bond sales last year was very serious, and the amount of bond sales dropped to the minimum of several years, but that condition has now passed, and the demand for high-grade bonds of counties, cities and villages seems to have no limit.

There has been some increase in the rate of interest on such bonds, due doubtless to the difficulty of disposing of them last year and the consequent attempt to make them more attractive to capital, and they are now more popular with many individual investors than railroad, public utility and industrial corporation stocks and bonds. This is true without reference to the stocks of companies having war orders, the latter being used to gamble with rather than for legitimate investment. In November the sales of municipal bonds amounted to $22,608,415, which was $5,000,000 less than in October and over $9,000,000 greater than in November, 1914. The total sales for the eleven months of 1915 ending December 1 were about $30,000,000 greater than in any preceding year of a decade or more and more than $230,000,000 in excess of the average of the preceding nine years.

The prediction made last year on this page is more than fulfilled, and the municipal field during the coming year will be more attractive to those who have constructing and operating machinery and materials usable in the work of improving and operating municipalities, keeping them clean and serving their citizens, than ever before.

Our daily bulletin reports of prospective work, as well as the contracting news pages, reflect this condition. A rather strenuous year, with unsatisfactory financial results to many, is succeeded by a very prosperous year, which bids fair to be the most prosperous that the country, but especially the municipal field, has enjoyed for many a year.

PATENTS ON ENGINEERING DESIGNS

For some time past, but particularly in very recent years, there has been a tendency among applicants for patents, particularly in the engineering field, to extend the definition of invention to cover the ordinary devices used in the designing department and even in the drafting room. Frequent attempts are made also to secure so-called basic patents upon the principles underlying these devices, no matter how well established in common use they may be. Such attempts are unsuccessful if the claims made are too broad, and in those which are successful the application of the principle is usually restricted to some particular material or kind of work to which it may not have been applied heretofore, so that the basic patent is basic in only a limited field.

The courts have not until recently noted or understood the consequences of this tendency, and have sustained more or less completely patents which cover not real inventions, but simply the application of well-known principles to particular problems. On the other hand, some such applications are really so novel, carry the evidences of invention so far, that only the most hypercritical can object to the issue of the patents. The average judge hearing cases involving infringement of patents of these classes finds it difficult to draw the line between real invention and mere drafting room detail. Indeed, the experts find it quite as difficult to make the decision, unless a count of noses is made, as they are lined up on opposite sides according to their ideas of what matters are subject to patent, their knowledge of patent law and practice, their financial and other interests.

Of late, however, the courts have had a tendency to look more closely into the antecedents of a patent, and there have been a number of decisions declaring patents invalid, when the court concluded from the evidence or from its own knowledge that the proper bounds of the definition of the term invention had been overstepped and the patent had been secured simply upon a variation in the application of well-known principles. Not all these decisions are right, because the court is not always well enough informed to be able to make a proper decision, and so some patents are declared invalid which cover real inventions.

This action of the courts reacts upon the Patent Office, and it is becoming increasingly difficult to obtain patents upon mere variations of devices which have no essence of invention. But the Patent Office also is not infallible, and mistakes are made both in issuing and in refusing patents.

In one recent decision the court decides definitely that "the claimant only made application of mere mechanical knowledge and skill, and that what he did is in no sense a demonstration of inventive genius." The court apparently acknowledges the propriety of issuing patents upon the use of reinforcing steel in concrete, which was involved in the suit, as demonstrating real inventive genius, altho he acknowledges that it has always been necessary to make special provision for tensile stresses in certain parts of a truss, girder or arch. But he denies that inventive genius is exercised in the placing of such reinforcement, and that mere mechanical skill is all that is necessary in making such designs. The issue here is definitely stated, and there will be much difference of opinion upon the justice of the court's decision. Advance is made in patent litigation, however, or rather in the prevention of patent litigation, when so definite a statement of the real point at issue can be made by a court, and, since decisions in favor of the same patents have been made in numerous other United States courts, it will now be possible to have this particular case decided upon its individual merits in the court of last resort.

PELHAM MANOR CONCRETE ROAD

By Charles A. Mullen, New York City.

This description of the design and the construction of a one-course concrete pavement with a thin bituminous wearing surface is by one of the men engaged in its construction, and gives some very interesting details. The method of making the joint between the two longitudinal sections, into which the pavement was divided in order to keep one side of the road open to traffic, is a special device, and the manner in which the joint carries the traffic will be watched with care, such longitudinal joints being particularly objectionable in concrete pavements. The street railway construction is also worth study and close observation as to its sufficiency under the conditions.

THE village of Pelham Manor lies just north of the corporate limits of the boro of the Bronx, New York City, on the shores of Long Island Sound. Its western neighbor is the city of Mount Vernon, and to the east lies the city of New Rochelle, also on the Sound. Pelham Manor is a high-class residential community made up of many extensive estates and beautiful residences set in parked plots. There is only one store in the village, the drug store near the Pelham Manor railway station.

There are but three thru traffic ways in Pelham Manor. The Shore Road and the Boston Turnpike both pass thru it on their way east, and Pelhamdale avenue is the only thru cross-road. It leads from the Sound northward to the juncture of Mount Vernon and the other Pelhams.

Two years ago, at a special election, the residents of Pelham Manor voted a bond issue to improve Pelhamdale avenue, then an old macadam highway and in very bad repair. The road was to be paved for its entire length of a mile and a half, beginning opposite the entrance of the New York Athletic Club's home on Travers Island and ending at the extension of Sixth street, Mount Vernon. The northern one-half mile section of Pelhamdale avenue is traversed by the double track main line of the Westchester Electric Railroad Company, and the remainder of the road, to the south of the historic Red Church that stands at the intersection of Boston Turnpike and Pelhamdale avenue, carries the single track branch running past Pelham Manor station and down to the New York Athletic Club grounds.

The village board, after carefully considering the nature of the road and the amount of the bond issue that had been voted, decided to construct a concrete pavement. They retained Mr. Edward F. Campbell, a well-known civil engineer and surveyor, whose office is at New Rochelle, to draw plans and specifications for and supervise the actual construction work.

The specifications prepared by Mr. Campbell were very thoro. They called for a uniformly 6-inch one-course concrete pavement, to be composed of one part of portland cement, one and one-half parts of clean, sharp sand, and three parts of what is known commercially as ¾-inch clean trap rock. He then provided for a bituminous top dressing of asphalt or Tarvia to be covered with ⅝-inch clean trap rock chips, this being the smallest commercial size recovered by the Trap Rock Company.

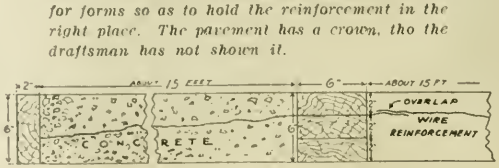
The contract was advertised and finally awarded to Mr. M. J. Leahy, of New Rochelle and New York City, the lowest bidder, at $1.35 per square yard, complete. This price included the removal of the old macadam road surface to an average depth of 6 inches, and the deposit of all the surplus not needed for building shoulders on the village streets within a distance of 2,000 feet, as directed by the engineer; the construction of the 6-inch one-course concrete pavement proper, the laying of the bituminous top dressing about one-quarter inch in thickness, and the shaping of the shoulders with the old macadam material placed alongside for the purpose.

After the village had signed the contract, the street railway company signed a similar contract with Mr. Leahy for the railway area, within, between and two feet outside their tracks. Ground was broken about April 20, and all the work proceeded at once. The street railway company reconstructed all their main line track, and thoroly overhauled their branch line. On the main line, they used a very heavy section 7-inch grooved rail, electrically welding the joints.

The grading was done in the usual way, with a rooter plow drawn by a heavy steam roller, and horses and wagons. The sand and stone were received by boat and hauled an average of two miles in White automobile dump trucks. The stone was furnished by the New York Trap Rock Company, and all the sand used was washed Cow Bay, furnished by the Phoenix Sand and Gravel Company. It was thought that the local bank sand, tho regularly used for foundation work, was not sufficiently clean and sharp for surface work. The portland cement was received in carload lots as used, the engineer being furnished with mill tests by the cement company as each car was shipped.

A Koehring concrete mixer was used, one of their regular road mixers, with skip for loading and boom and bucket discharge. The measuring and loading was by boxes of exact dimensions bolted to wheelbarrow platforms, the front of the box having a sloping side for convenient dumping. Two-by-six-inch spruce side-forms were used, the rail serving for one side. The concrete was mixed fairly wet, and struck with a steel-bound four-by-six timber having handles at each end. There was no curvature in this template, and care was taken to see that it remained perfectly straight. The surface was then finished with a float handled by a man on a bridge in

CROSS-SECTION *of concrete street, showing method of reinforcing joint down the center of the pavement, due to laying one side at a time. It also shows the method of laying the concrete on the first half constructed and location of planks for forms so as to hold the reinforcement in the right place. The pavement has a crown, tho the draftsman has not shown it.*



the usual way, and was broomed as it stiffened to roughen slightly the surface transversely of the road.

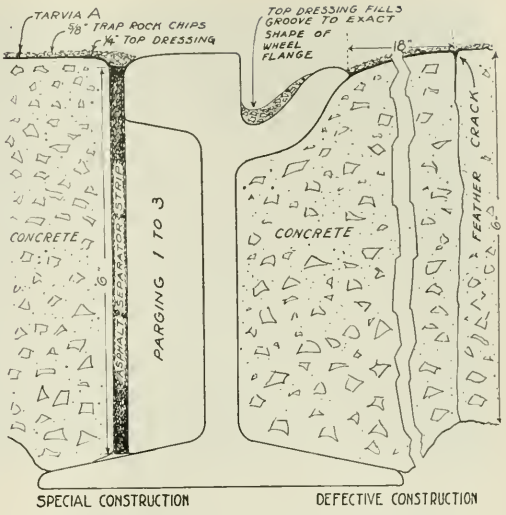
When the entire concrete work was completed, the surface was swept absolutely clean, house brooms being used for the final sweeping. Tarvia A was then applied from high pressure distributers, and the trap-rock chips were applied as a covering. The trap-rock chips had previously been deposited in piles about fifty feet apart along the sides of the road, and were spread upon the tarviated surface by means of wheelbarrows and shovels, which method proved satisfactory. One-third of a gallon of Tarvia A and one-hundredth of a cubic yard of stone chips were used to each square yard of road.

Several interesting features in the construction of this concrete road were the detail of construction at the rails, the reinforcing of a section at the Shore Road, about one hundred feet long, in which there was no car track, and the use of stone chips instead of torpedo gravel for the covering of the bituminous top dressing. The crown of the road was in straight lines with a drop to the sides of one-quarter of an inch to the foot. From the car rail to the side of the road was ten feet in all cases, making the single track section about twenty-five feet in width, and the double track section about thirty-five feet. The contraction joints were located twenty-five feet apart, and were made with asphalt separator strips furnished by the Hydrex Felt and Engineering Company. The shoulders of the road sloped away at the rate of about one inch to the foot, and formed the gutter.

The idea of using crushed trap-rock chips for covering the bituminous dressing on a concrete road is an innovation, the credit for which, as far as the writer has been able to learn, belonging entirely to the engineer on this work, Mr. Edward F. Campbell; for, at least in this section of the country, torpedo gravel has always been used. The trap-rock chips make a much better appearance than the torpedo gravel, seem to keep their place on the road better, and in the writer's opinion, are going to prove much more satisfactory in the long run. After a little traffic, the surface looks about the same as a well-built bituminous macadam pavement with squeegee top dressing, and is exceedingly pleasing to the eye of the autoist. It was at Mr. Campbell's special request that Tarvia A was used as a bituminous binder in this work.

At the south end of the job, where the single track stops, about one hundred feet from the Shore Road, Mr. Campbell provided for reinforcement, and because of the lack of a convenient way around, this had to be placed without stopping traffic at this point. It was necessary to lay the width of about thirty feet in two sections, and it was particularly desired by the engineer and the village authorities not to have an open joint parallel to the traffic, but to have this section as nearly as possible a continuous block across the road, with the usual twenty-five-foot contraction joints running from side to side. This was accomplished in as satisfactory a manner as seemed possible, in the following way:

A form was set on one side of the road in the usual way, and a special form was made along the middle of the road by placing three two-by-six-inch side forms upon one another flat. Then the grade was regulated properly, and the top board of the center form was removed, leaving the center form temporarily four inches high. The concrete mixture was next dumped in place and raked to a depth of about four inches all over, when the wire-mesh reinforcement was laid in and allowed to project about two feet over the center form. Then the top board was returned to its place on top and nailed, the wire being between, when the top two inches of concrete was at once applied and the surface struck. This method worked well, and when it came to doing the other side several days later, the special three-ply forms were removed, the projecting two feet of reinforcement overlapped, and the concrete laid, using the set concrete as the middle form. This provided continuous blocks of concrete twenty-five feet long and extending from side to side of the road, about thirty feet, with what amounts to continuous reinforcement all the way. It remains to be seen whether or not the break in the center will prove a source of weakness. The writer thinks not; that is, not in a sense that will detract from the value of the road.



CROSS-SECTION *of concrete road construction along street car rail. The incorrect construction on the right side of the rail results in a crack about eighteen inches from the rail. The special construction on the left side of the rail allows for some rail movement, and will probably save the crack in the concrete.*

Laying any pavement abutting a street railway track is always a serious problem, and laying a concrete pavement there is a very serious matter. After a conference between the engineers and the contractor, the railway company agreed to pay for a special construction along the outer side of the outer rails, adjacent to the ten-foot-wide slabs of concrete pavement, but would not go to the extra expense between and within the tracks. The special construction consisted of pargeting the side of the rail from the edge of the head down in a perpendicular line to the point on the base where such a line happened to strike; and care was taken to see that the pargeting, which was a one-three mixture of portland cement and Cow Bay sand, did have a perpendicular side. Against this pargeting was placed a six-inch deep by one-quarter-inch wide asphaltic separator strip furnished by the Hydrex Felt and Engineering Company, the same that was used for the transverse or contraction joints spaced every twenty-five feet along the road.

The asphaltic separator strip was held against the pargeting by means of thin boards and spikes until the wet concrete was in place, when the boards and spikes were drawn and the finishing was done.

It was the writer's opinion that the use of the asphaltic separator strip between the perpendicular pargeted side of the rail and the mass of the concrete pavement would serve two purposes. In case of a slight settlement of the rail, it would give and prevent the rail from carrying down with it a sec-

PELHAMDALE AVENUE *concrete road. Concrete surface on half the road before bituminous top dressing was applied. Double track street railroad.*

tion of the concrete pavement about eighteen inches wide by causing the concrete to crack about that far from the rail; and the asphaltic separator strip, because of its plastic nature, also somewhat elastic, would act to arrest the vibration of the rail as heavy cars passed over it, thereby saving the concrete from this destructive action. Since the work has been finished, the first contention has been proven. In places where the rails did settle, tho merely a small fraction of an inch, on the side where the special construction was used the pavement showed no signs of damage whatever, while on the inner side of the rail a hair crack appeared about eighteen inches away from the rail, and a slight movement was noticed. This was not only true in one spot, but in several places. The damage was not serious, and now that the bituminous top dressing has been applied, is not noticeable and may never cause any serious trouble on a road of only moderate traffic and on the inside of the rail. It would seem that no other result could be expected from running the concrete under the head or lip of a girder rail so that it sets firmly against the web; certainly, if the rail goes down ever so little, the concrete must go down with it, and something must give. The price for the special construction was five cents a running foot, including pargeting and asphaltic separator strip, but it displaced three cents worth of concrete road, so that the net cost was but two cents per running foot. It seems to the writer that it is

PELHAMDALE AVENUE *concrete road, single track street railroad. Concrete completed, but bituminous top dressing not yet applied.*

easily worth that added expenditure; especially so on the outer side of the rail, where a break would come directly at a point of heavy wheel traffic; and even on the inner side.

Before the top dressing was applied to the road, its full length was carefully inspected and all defects were remedied. tho there were none of real importance found. The road had been open to traffic about ten days after each section was completed, and the contractor's twelve-ton macadam roller had been up and down it several times without effect.

The Pelhamdale avenue concrete road will undoubtedly be watched very carefully by many road engineers in and around New York City. Many have already examined it, and they will be back for further observation from time to time. As it is the closest considerable stretch of concrete road near New York City, and is known to have been laid under very strict inspection, it will probably be a show road for advocates of concrete road construction and bituminous top dressing.

Mr. Edward F. Campbell, the village engineer, spent a good part of each day on the work, and when absent, was competently represented by an engineer inspector in his employ, Mr. John Christal. Mr. E. M. T. Ryder, the engineer of maintenance of way of the Westchester Electric Railway Company and the Third Avenue system, also gave the road some personal attention, and was represented by Mr. John A. Gunn, a regular employe of his office. Mr. J. C. Wilberding, the president of the village of Pelham Manor, took a keen interest in the construction of the road, and with the asistance of Mr. Campbell, followed its every detail.

At the contractor's selection, because of his long personal experience with it, Giant portland cement was used exclusively, and this brand proved by frequent personal tests to more than meet the standard specifications, and entirely satisfied the engineer. Mr. Leahy has a five-year guarantee on the road, and states that he is not afraid of it.

Electrolysis in Providence, R. I.

Electrolytic conditions in Providence, R. I., have been under investigation for the past year or more. It was reported a year ago by the public service engineers, Robert L. Brunet, that stray currents from the street railway system were causing material damage to water and gas mains and also affecting telephone cables.

In a report issued recently to the Commissioner of Public Works, the engineer details the injuries done, tests having been made for potential differences between the railway company's rails, and the water and gas pipes, between rails and bridges, bridges and river and between water mains and river.

On the whole, conditions have improved over those found a year ago, which would indicate an improvement in rail bonding. The effect of rail drainage depends on the radius from the power station. In Providence, some distances are long, and to reinforce rail drainage additional negative return feeders must constantly be installed, to limit the liability of damage and also to economize power.

Specimen effects of electrolytic action were the corrosion of lead services which necessitated the renewal of service pipes in a large number of cases; the pitting of a main to the depth of ⅛ to ¼ in.; the complete breakdown of service pipes, resulting in flooding; practical destruction of a water meter; and marked deterioration of a water main attached to a bridge.

In the above cases a difference in potential was found: between water pipes and tracks, 1 to 2½ volts; between water and gas pipes, 2½ to 5½ volts; between rails and bridge, 1.1 volts; rails and water main, 1.1 volts and bridge and water pipe, .2 volts.

Tests of gas mains of the Providence Gas Co. showed a difference between gas pipe and rails of 2.9 to 4.2 volts and a flow of 4.1 to 8.3 amperes from mains to railway track. A gas main was found conveying 52 amperes from the river and transferring it to the track system at some distance.

Mr. Brunet reported that of the 946 open and 1,245 defective rail joints of the Rhode Island Co., a large number have been remedied. It was found too expensive to put in effect the engineer's recommendation to weld the joints electrically, but the official holds it to be the railway's duty at least to weld the rail bonds electrically.

Another recommendation is that pilot wires be connected to various points on the track network and run to the basement of City Hall, to be used in connection with smoked chart instruments which would indicate the over-all potential variations between which measurements can be made. The railway company is further asked to renew at once all broken and imperfect rails, and adopt the gradual system of electrically bonding rail joints.

The Utilities Bureau

Suppose the citizens of Jonesville make up their minds that the rates charged by their gas company ought to be lower. Jonesville has 40,000 inhabitants. Their gas company is capitalized at $700,000. The contest does not look unequal. It would not be unequal if the gas company were really as isolated and self-dependent as Jonesville.

But the gas company is not dependent upon itself alone. It is controlled by a holding company capitalized at $110,000,000. If the holding company cares to, it can put more money and experter experts into this case than Jonesville can afford. The case may raise questions certain to come up again in disputes between other communities and other plants controlled by the holding company. The more important the case, the less likely is Jonesville to present its side as forcibly as money and organization enable the holding company to present the corporate side.

Holding companies control nearly five and half of the eight billions invested in American gas, electric, street railway and iuterurban railway companies. About 89,000,000 persons are served by electric light and power and gas companies. Holding companies serve sixty-two of these eighty-nine millions, or about 70 per cent. Holding companies control 76 per cent. of the two billions invested in electric light and power; two-thirds of the billion and a third invested in artificial gas; two-thirds of the five billion invested in street and interurban railways.

The functions of this Utilities Bureau are to collect and collate data as to rates, service standards and cost factors in municipal utilities; to prepare these data for use of cities, public bodies, corporations and interested citizens; to help by study and advice cities that want help in solving their utility problems; to codify the decisions of public service commissions and other judicial and quasi-judicial bodies; to make and keep up a list of engineers, lawyers, accountants and valuation experts; to encourage the introduction of cost-keeping methods, similar to those followed in the industries, thruout the utilities, whether publicly or privately owned, and to develop standard forms and methods for reporting basic facts; to serve as a national agency thru which American cities may co-operate by exchanging data as to cost factors, service standards and rates.

The Bureau is organized with Charles R. Van Hise, president of Wisconsin University, as president, and men prominent in municipal betterment movements on its board of trustees and mayors of the large cities as sponsors. Morris Llewellyn Cooke of the Philadelphia department of public service is acting director, with his office at No. 216 Philadelphia City Hall, and will give any desired information regarding the work of the Bureau.

THE ACTIVATED SLUDGE METHOD

OF SEWAGE TRATMENT

This brief history of the rapid development of the activated sludge method of sewage treatment is abstracted from the results of the research of Prof. Edward Bartow, of the University of Illinois, who is at the head of the water survey of the state. It shows that there is much promise in this latest attempt to solve the great problem of the disposal of the sludge resulting from sewage treatment, in part by destroying some of it in the treatment process, in part by making it innocuous and practically inoffensive, and in part by giving it some value as a fertilizer not too low in grade for practical use.

Sewage treatment by aeration in the presence of sludge is the latest development in sewage disposal.

Air has always played an important role in sewage disposal. The earliest application of air was the exposure of sewage on the ground or in shallow pools. The disposal of sewage by irrigation is an aeration process. No more sewage can be added to land than can be thoroly oxidized. The disposal of sewage by dilution in streams also depends on the amount of air present. The amount of sewage which can be purified by a stream is limited by the amount of dissolved oxygen present.

Intermittent sand filtration where sewage is added intermittently to sand beds is an aeration process. The action of contact beds is of a similar nature. Sprinkling filters, the most practical process up to the time of the suggestion of activated sludge, depend upon aeration accomplished by spreading the sewage in a finely divided state into the air.

Preparatory treatment of the sewage is necessary, and consists in using screens, grit chambers, settling tanks, digestion tanks or chemical precipitation, according to conditions.

Grit chambers and settling tanks remove suspended matter. The amount of purification is comparable with the amount of purification by screening.

Digestion tanks accomplish the partial destruction of the suspended solids and soluble organic matter by anaerobic bacteria.

The addition of chemicals assists sedimentation and retards digestion, giving an increased amount of sludge, but a much improved effluent. Neither the screening nor the sedimentation nor the digestion nor the chemical precipitation produce complete purification. Aeration processes must complete the purification.

Edward Bartow, of the University of Illinois, in a paper before the Iowa section of the American Water Works Association, discusses the latest process, the aeration of sewage in the presence of sludge, and also gives results of tests of sludge as fertilizer

Numerous experiments of blowing air into sewage have been made, both in America and in Europe. Until recently none of the experiments were at all promising and the conclusion was that such means of purification was not practical. In this country, the first promising method was that used by Black and Phelps in New York. They blew air thru the sewage as it passed over a series of inclined wooden gratings. This sewage was in contact with the air for varying periods up to twenty-four hours. The experimental tank has been adapted to experiments with activated sludge.

The next experiments are those reported by Clark and Gage and Adams at the Massachusetts State Board of Health experiment station in Lawrence. Air blown thru sewage reduced the organic constituents. The seeding of the sewage with green growths accelerated the action. Their best results were obtained when the tank contained slabs of slate covered with a brown growth of sewage matters. This treatment produced an effluent which could be filtered at several times the normal rate. It, however, simply prepared the sewage for addition to sand beds, and was not considered a final process.

Gilbert J. Fowler, of the University of Manchester, was in this country in November, 1912, in connection with the disposal of the sewage of Greater New York and visited the Massachusetts experiment station. Fowler and Mumford carried on experiments with a specific bacillus, which they named M-7, which was collected from the waste water from a colliery. This bacillus with aeration has the power of separating iron as ferric hydroxide from iron-bearing sewage, carrying down with it the suspended matter, and furnishing a non-putrescible effluent. Fowler sugested to Ardern and Lockett, who were in charge of the Manchester sewage disposal works, that they try experiments in aerating sewage on lines somewhat similar to what he saw in Massachusetts. As a result, the activated sludge process is being developed.

The first description of it was given by Ardern and Lockett, April 3, 1914, at a meeting of the Manchester section of the Society of Chemical Industry. In their first experiments, Ardern and Lockett used bottles having a capacity of five pints, and drew the air thru the sewage by means of an ordinary filter pump. Air was drawn thru the sewage until it was completely nitrified, requiring about five weeks. The supernatant liquid was drawn off and additional sewage added. This method of treatment was repeated a number of times with the retention each time of the deposited solids. As the amount of deposited matter increased, the time required for each succeeding oxidation gradually diminished. Finally, a well-oxidized effluent, equal to that from efficient bacterial filters, was obtained in from six to nine hours.

In their second series of experiments, reported to the Manchester section of the Society of Chemical Industry, November 6, 1914, they used barrels of fifty gallons capacity and added the air thru porous tile. They have tried treatment with a continuous flow of sewage without conclusive results. In later experiments they used tanks of 20,000 gallons capacity. Their results were very satisfactory and led to additional work in England, especially at Salford, where Duckworth and Melling adapted scrubbing filters to the use of the activated sludge process with great success.

Experiments were begun with F. W. Mohlman at the University of Illinois on November 2, 1914, using bottles of three gallons capacity. On January 4, 1915, a tank nine inches square and four and one-half feet deep was put in operation. In the bottom of this tank was placed a porous plate made of material known as "Filtros," furnished by the General Filtration Company, Rochester, N. Y. The plates are made of a very pure and carefully graded quartz, fused together with powdered glass. The results of our first experiments were similar to those of Ardern and Lockett. Sewage placed in the bottles or in the little tank was submitted to a current of air for a sufficient period to oxidize it completely.

It is not necessary to obtain complete nitrification to ob-

tain a clear or stable effluent. More information must be obtained before the amount of nitrification required can be known.

The process is undoubtedly bacteriological. The sludge is very rich in bacteria but the number in the effluent is comparatively small. In our laboratory, Mr. Robbins Russell investigated the bacteriological properties of the sludge. Several species of bacteria were isolated from the sludge, including two kinds of nitrifiers and about fifteen other varieties. Experimenting with sterilized sewage, it was found that the nitrifiers alone would not purify the sewage. Mixtures of the nitrifiers with the other bacteria would completely purify the sterilized sewage.

In an article which was presented before the American Chemical Society, mention was made of some worms which developed in the process and which were identified by Professor Frank Smith, of the zoological department of the University of Illinois, as Aeolosoma Hemprichi. It seemed possible that these worms might play an important role in the purification process. Having isolated about two hundred of these worms as completely as possible from the bacteria and sewage, Mr. Russell added them to sterilized ammonia broth and aerated it, obtaining practically no nitrification. The worms are, therefore, not essential and the bacteria which were isolated from the sludge did nitrify sterilized sewage.

The fresh sludge is odorless. It will putrefy if left with a large amount of water. After filter pressing it is stable. The dried sludge has an odor similar to that of fertilizers.

As in other sewage disposal processes, the ultimate disposal of the sludge is of great importance.

The disposal of the sludge can be most easily accomplished if it has manurial value. That activated sludge has manurial value is shown by its chemical composition, by its reaction with various soils, and by its effect on the growth of plants. Specimens of sludge obtained at the experimental plant have varied in nitrogen content from 3.5 to 6.4 per cent. The lower values were obtained during periods of high water. Street wash was getting into the sanitary sewers and since no grit chamber was provided to remove the grit, the nitrogen value of the sludge was greatly lowered. The tests of the fertilizer value have been made on the richer specimens which were first obtained.

Thru the courtesy of Mr. Paul Rudnick, chief chemist, Armour & Company, Chicago, the availability, according to alkaline permanganate method as used by the New England states was shown to be below 50 per cent. (44.7 per cent.), and the sludge would be classed as an inferior ammoniate, but the availability according to the neutral permanganate method which has been adopted by the southeastern states was shown to be about 85 per cent. (89 per cent.) and would therefore be classed as satisfactory.

While it seems to hold a medium position, it nevertheless resembles very much more closely in its general characteristics, so far as available nitrogen is concerned, the so-called high-grade organic nitrogenous fertilizers, dried blood and high-grade tankage, etc., rather than the low-grade nitrogenous fertilizers, steamed bone meal, cotton seed meal, garbage tankage, etc.

Although the chemical tests and the nitrification tests with soils indicate that the activated sludge has a high fertilizer value, the final test must be its effect on plant growth. Pot cultures, using wheat, were started in March, 1915, under the general direction of Professor C. C. Hopkins and with the assistance of Mr. J. C. Anderson, details of which are given in the paper.

The sludge causes such a rapid growth of wheat, that it should be valuable to truck gardeners, to rush the spring crops. To test its value to the market gardener, three plots, each two feet by three feet, were laid out in a field. One plot was not fertilized, one was fertilized with an equivalent to 126 pounds of nitrogen, one ton of sludge per acre, and the third with an equivalent of extracted sludge. On April 24, 1915, two rows of radishes and lettuce were planted in each of the three plots. The plants in the plot where the extracted sludge was used came up first, a little ahead of those in the plot where the unextracted sludge was used. At the end of two weeks, the lettuce and radishes of the treated plots appeared to be twice the size of those in the untreated plot. At the end of four weeks the plants were thinned. The roots of the radishes from the treated plots were already red and quite rounded near the tops, while those from the untreated plots had not yet started to swell and had not become red. The lettuce plants from the treated plots were nearly twice as large as those from the untreated plots.

The increase in weight, due to the sludge, is 40 per cent. in the lettuce, and of 150 per cent. in the radishes. The radishes from the sludge pots when cut open and eaten were found to be very crisp and solid, and to have a good flavor. They were weighed.

These pot cultures and gardening experiments show that the nitrogen in "activated sludge" is in a very available form and that activated sludge is valuable as a fertilizer.

The process is attracting a great deal of attention in America. The most extensive work is being done at Milwaukee. Two tanks of 1x5x10 feet deep and one tank 10½x32x10 feet deep have been operated on the fill and draw plan and one tank 10½x32x10 feet deep is operated on the continuous plan. The Milwaukee sewerage commission has awarded contracts for the construction of a plant to treat 2,000,000 gallons of sewage per day by continuous flow. At Baltimore, they have been working on a small scale but have adapted two of the new Imhoff tanks for use by this process, and it is expected that in a short time they will be using activated sludge on a large scale. At Washington, the Hygienic Laboratory of the Public Health Service is experimenting on a small scale and is co-operating with the department at Baltimore in their experiments. At Cleveland, experiments are being carried on in the sewage experiment station. They have adapted tanks 5x10 and 5 feet deep, which they used in their sewage experiments, to the process, and while it has barely begun, they are getting promising results. Experiments are to be carried out on a larger scale. At Regina, Saskatchewan, experiments on a considerable scale have been carried out and their results are reported by R. O. Wynne-Roberts. At Houston, Texas, they are planning to use the process in a plant to ultimately treat the sewage from 160,000 people. They do not expect to obtain complete nitrification, as they do not believe that a completely purified effluent is necessary. In Chicago, the Sanitary District of Chicago is using tanks about 2 feet in diameter and 8 or ten feet high with quite satisfactory results, using the waste from the stockyards, one of the most difficult wastes that we have to treat.

At the University of Illinois, four reinforced concrete tanks have been completed and put in operation. These tanks operating on the fill and draw system, are designed for studying in a comparative manner the amount of air required, the best method for distributing the air, the time required for purification, and the quantity and quality of activated sludge formed. The paper contains detailed descriptions of these tanks and methods of operation of them.

The quality of the effluents has usually depended more on the strength of the raw sewage than upon any other variable. The tanks when operating on a six-hour cycle, were filled at 9 a. m., 3 p. m., 9 p. m. and 3 a. m. The strength of the raw sewage, estimated by the free ammonia values, averages for the 9 a. m. sewage between 20 and 35 parts per million, for the 3 a. m. sewage, between 3 and 12 parts per million. Nearly all of the 3 a. m. sewages have given stable effluents, but the

strong morning sewages have quite frequently given putrescible effluents. Unless the sludge is in good condition, and well nitrified, a strong sewage cannot always be purified in four and one-half hours, even by increasing the air to 800 cubic feet per 400 gallons. In the normal working of the plant, the sludge will usually regain its "activity" if 800 cubic feet of air is applied for several periods after the strong sewage has been added. At times, however, with a succession of strong sewages, it is necessary to increase the time of aeration in order to obtain good effluents. When strong sewages are to be treated, a definite cycle of operation cannot be established without provision for longer aeration of the sewage or separate aeration of the sludge. In order to keep the sludge in its most active state, complete nitrification of each sewage is necessary. Effluents are usually stable if 50 per cent. of the free ammonia is removed, and 2 to 3 parts per million of nitrogen as nitrates is present. A completely nitrified effluent is neither necessary nor economical. The greatest efficiency in air consumption will be obtained when enough air is used to make the sewage non-putrescible and to keep the sludge activated. The operation of the plant during six months has suggested the advisability of studying more carefully such other features of the process as the amount of sludge formed, the building up of nitrogen in the sludge, and the composition of the effluent gases.

THE WATER SUPPLY OF WATERLOO, IOWA

In 1886, Waterloo, Iowa, had a population of 10,000 and installed a water works plant with mechanical filters to purify the water pumped from Cedar river. The supply being inadequate and not always of the best, the development of artesian wells was begun in 1904. The following description of the wells is abstracted from a paper before the Iowa section of the American Water Works Association, by J. P. Berry, the superintendent of the plant.

W. H. Gray & Bros., of Chicago, contracted to drill a 15-inch well to a depth of 200 feet, then 9 inches to a depth of 484 feet, and 8 inches from there to the bottom, a depth of 1,375 feet. A great deal of trouble was experienced, especially in the first 200 feet of 15-inch hole. The first water-bearing artesian sands were found at a depth of 840 feet, and were about 40 feet thick, the water rising to street grade. At a depth of 1,300 feet, a stratum of Potsdam or Jordan sand was found, 75 feet thick and pure white, from which the discharge was 210 gallons per minute, with a head of 19 feet. This well was completed in July, 1905, just one year after drilling was commenced, at a cost of $5,721.79.

This well was equipped with a Byron Jackson deep well pump placed in the well to a depth of 106 feet, and driven by a Filer and Stowell engine delivering 700 gallons per minute. Water stood at a depth of 75 feet below the surface when the pump was in operation. This well was operated continuously for two years, when, on account of caving of the well at the 800-foot level, it was found necessary to shut down for repairs. The well was cleaned out and 350 feet of casing was added, extending up into the 15-inch pipe, with a lead seal placed between the pipes to prevent the entrance of surface water.

In November, 1914, it was found by analysis of water taken from this well that surface water was finding its way into the artesian supply. We decided at this time that we would pull the old casing and replace it with new. The word "casing" is used here only to show its purpose in the well, as standard drive pipe was used in all cases, not the light pipe usually called casing. For making our repairs, we purchased from the Armstrong Mfg. Co., Waterloo, Iowa, one of their largest size drilling machines, large enough to drill any future wells the city may need, and make any repairs that may be necessary on our present wells. In pulling our casing, what is known as a Fox trip spear was used, and the casing was removed without any trouble. The casing was found to be badly rusted, some places entirely rusted away, and in other places as thin as stovepipe. This was steel pipe and I have seen wrought iron pipe that had been in service over twenty years in the same kind of water that was in better condition than our pipe was at seven years. A word to the wise should be sufficient.

New wrought iron standard drive pipe casing was placed in this well, seals were placed between the different sizes of pipe and the well was put in operation. Analyses showed that surface water had been entirely shut out. The repairs on this well were made in about sixty days, and during this time the well drilling machinery was operated by electricity. It worked well and at 2 cents per k.w., electricity cost us about $12.90 for the entire job. It has not been necessary to do any repair work on any of the other wells.

No. 2 well is almost a duplicate of No. 1. It is operated by a 40-h.p. motor belted to a deep-well centrifugal pump, and when first tested the well delivered 700 gallons per minute. This well was drilled in 1907 and has been in service almost every day since that time. First tests of this well showed that when the pump was delivering 700 gallons per minute the water stood 75 feet below the surface, and more recent tests show that the water stands at the 100-foot level, and that the discharge of the pump is a little over 600 gallons per minute. This is due to the lowering of the head and perhaps some to the condition of the pump. The cost of this well was $8,053.51.

Well No. 3 was drilled in 1911. Its depth is about the same as the other wells, but its size is much larger, being cased 20 inches to a depth of 200 feet. From this point to a depth of 860 feet it is cased with 12-inch pipe, and from this point to the bottom, 1,377 feet, it is drilled 12 inches. This well was equipped with an 18-inch centrifugal pump, direct connected to a 75-h.p. electric variable-speed motor, that is, the pump may be run at either 850 r.p.m. or 1,150 r.p.m by changing the switch.

In this well the water from the St. Peter or first water bearing sands, is cased off, and for this reason, we have not derived much benefit from the high speed of our pump, as at 1,150 r.p.m. the pump does not fill. At 850 r.p.m. the pump delivered 800 gallons per minute. The cost of this well was $10,854.56.

Well No. 4 was drilled in 1914 and is 1,378 feet deep. The first 200 feet is cased with 15-inch wrought iron casing, the next 675 feet is cased with 9-inch casing. The 9-inch goes to the bottom of the St. Peter sand and where it passes thru the St. Peter sand it is perforated to admit the water from these strata. This well is equipped with an American deep-well pump and a 60-h.p. direct connected motor. This motor is using about 56 k.w. per hour and the pump is delivering about 800 gallons of water per minute. This well seems to be our best well, everything considered. It was drilled by the J. P. Miller Artesian Well Company. The time required to drill this well was about five months, while all of our other wells required a year. The cost of this well was $8,356.00.

Our four artesian wells are located in a space of about 4,000 feet, the first three in 2,000 feet, and the fourth 2,000 feet away. We find that there is some interference between the different wells.

Ornamental Street Lighting Units

By Gilbert T. Dunklin, South Bend, Ind.

This brief article gives an idea of some of the later designs for ornamental street lighting units, departing from the earlier heavy cluster designs, which had a very heavy effect by daylight not entirely compensated for by their usefulness at night. With the higher candle power lamps now available the single lamps give as good service as the clusters did and are much handsomer, both by day and by night.

THE introduction of Mazda "C" (gas-filled) lamps has revolutionized methods of ornamental street lighting. The pretty, but wasteful, cluster posts have given way to the more efficient and dignified single light posts. In place of clusters of small multiple lamps, posts now support single light units of high candle power. The method of current distribution has changed from 110 to 220-volt multiple circuits using either two or three conductor cable, to high potential series circuits using single conductor cable. These changes are due largely to the distinctive qualities of the new lamps; the most important of these influence the design and selection of modern street lighting units and may be stated briefly as follows:

1. Mazda "C" lamps are made in large sizes permitting wide spacing of lighting units. This reduces the initial cost of installation to a minimum.

2. The new lamps are more efficient in the large sizes than in the small sizes, consequently the maintenance cost is less for single units of high candle power than for clusters of small lamps affording the same amount of illumination.

3. The large series lamps, especially those made for 15 and 20 amperes, are the most efficient incandescent lamps for commercial purposes on the market today. Not only is the initial cost of installation greatly reduced by the use of single conductor cable for high potential series systems, but the amount of current consumed by the 15 and 20-ampere series lamps is about 25 per cent. less than for multiple lamps of approximately equal candle power rating.

4. Series lamps are more rugged in construction than multiple lamps. Their life is longer and consequently the expense of lamp renewals is less for series systems than for multiple.

The peculiar operating characteristics of the new lamps have a most important bearing on the design of the lighting unit. The conditions to be fulfilled are as follows:

1. Sufficient ventilation to prevent excessive heating of the lamps.

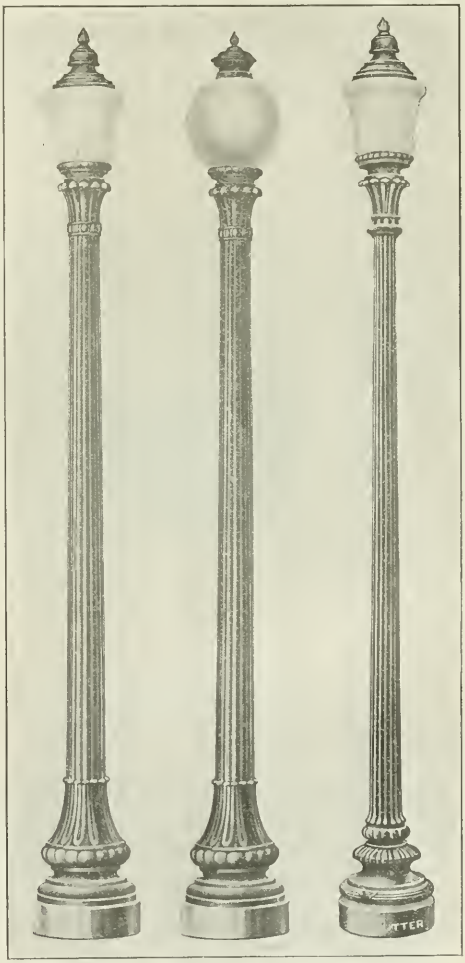
2. Elimination of glare due to the high intrinsic brilliancy of the concentrated lamp filament.

Ventilation is provided by means of a globe with two openings. Two styles are illustrated in Figures 1 and 2. A ventilator covers the top opening of each globe, thus protecting the lamps from moisture. Insect screens are provided in both globe holder and ventilator so that frequent cleaning is not necessary.

Glare is eliminated by mounting the units at the proper height above the sidewalk and concealing the lamps in globes of diffusing glass. The final results depend upon the shape and compositon of the glass used.

Cadillac (Mich.) Installs Efficient Lighting Units.

In May, 1915, post tops of various shapes and styles were submitted for trial and test at Cadillac, Michigan. Luminometer readings were taken on the street surfaces. The unit illustrated in Fig. 1 was selected as the most efficient and artistic. The filament of the lamp could not be seen and the absorption of light was less than for any other glass available. Characteristic light distribution with this type of globe is illustrated in the upper polar diagram, Fig. 4. Here it is compared with the ventilated ball-shaped globe which allows more

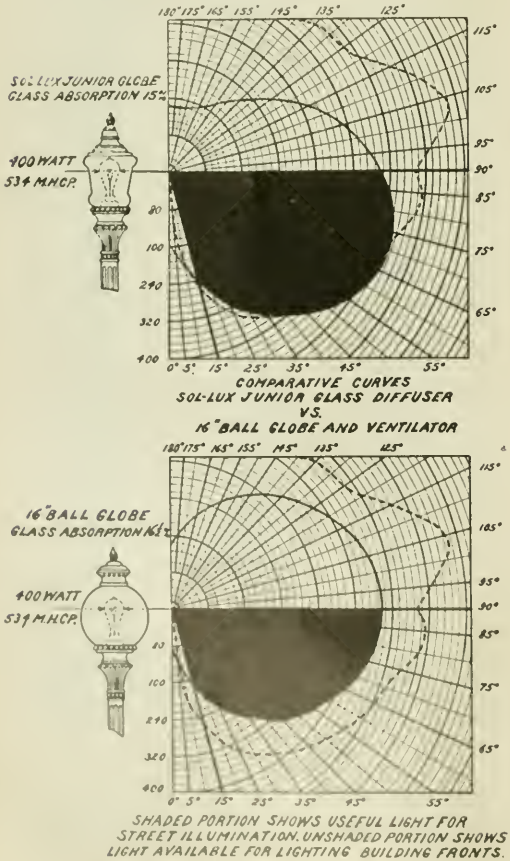


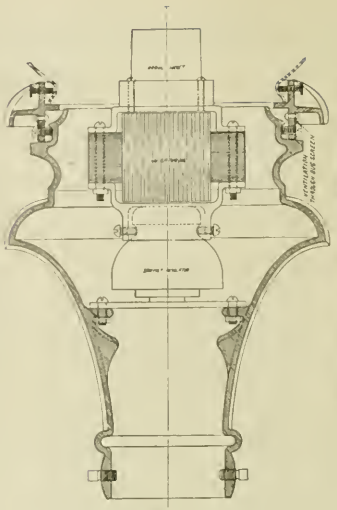
LEFT. *Continental post with Sol-lux, Senior, ornamental top.* CENTER. *.Continental post with sixteen-inch ball globe and ventilator.* RIGHT. *Parkview post with Sol-lux, Junior, ornamental top.*

light to be directed above the horizontal than is necessary for the adequate illumination of building facades. The amount of useful light for the illumination of street surfaces and sidewalks is represented by the shaded portions of the two diagrams. In the diagrams, broken lines indicate candle power values of the bare lamps, while full lines show corresponding candle power values of the same lamp enclosed in diffusing globes. By the use of an internal reflector, attached to the ventilator directly above the globe, a greater density of light is obtained from the "Sol-lux" unit between the angles of 45 degrees and 70 degrees than from the bare lamp. In these directions, the greatest amount of light is needed for ornamental street lighting purposes.

One especial advantage of using the new high candle-power units is that objects on the street are seen more easily by contrast than on streets lighted by clusters of small lamps. Clusters afford more diffusion than single light units, but it has been demonstrated that surface irregularities and moving objects are discerned by contrast more easily if the light comes from one direction than by light coming from a number of directions. With the new single-light unit installed at Cadillac, the greatest amount of light comes from that direction most

POLAR DIAGRAMS *showing light distribution and absorption.*





SECTIONAL VIEW *of ornamental post top, showing method of insulating compensator coil and socket from post.*

POT HEAD.

useful for street lighting purposes. This unit is therefore superior to both the cluster top and the ball globe. Its design is attractive and particularly applicable to modern street lighting systems.

The solution of such problems as the prevention of grounds and static discharges is of utmost importance in the design of series underground circuits. In Cadillac, a pothead was installed in the base of each post. It consists of an iron frame with receptacle for insulating compound and with clamps for holding the cable. A porcelain cover has two holes for the wires which lead to the socket in the top of post and a third hole for sealing the connections. The iron frame which forms a part of the cable clamp is fastened directly to the base of the post. This affords a complete circuit for static current and makes a permanent connection from the post thru the cable coverings to ground.

The socket and lamp are separated from the iron post by means of a high tension porcelain insulator, as shown in Fig. 5.

By means of these protective devices, all danger to pedestrians and linemen are eliminated.

Other cities have adopted the same unit. A few of these are: Fort Dodge, Iowa; Prairie du Chien, Wisconsin; Neillsville, Wisconsin; West Liberty, Iowa; Huntington, Indiana.

At West Liberty, Iowa, the standard shown complete in Fig. 1 is used in the mercantile section of the city. In the residence districts, a smaller post and top, illustrated in Fig. 3, are used. In this way, the same decorative scheme is carried out thruout the city. The ornamental top is made in two sizes, one harmonizing with the heavy standard which is appropriate for "White Way" lighting, the other for a small standard, designed especially for the lighting of parks and streets in the residence districts. The two globes are made of the same glass and the light distribution is approximately equal for both. Huntington, Indiana, has adopted this scheme of a systematic and efficient system for the entire city. Approximately 400 posts will be installed by January 1. This installation will be a striking example of what may be accomplished by a city of this size by the use of single-light posts and it will conform to the latest ideas of efficient and artistic street lighting.

Bituminous Resurfacing of Old Roads

By J. C. Travilla, C. E., Fort Worth, Texas.

Mr. J. C. Travilla, of Fort Worth, Tex., and St. Louis, Mo., has been constructing roads in Texas, particularly in Tarrant county, and has developed some special methods, the principles of which are stated in this article, part of which is from a paper before the International Road Congress, and part from a brief report of the work done in Tarrant county. His conclusions are clearly stated and are worthy of careful study, as they may be applied with advantage under similar circumstances anywhere.

In the resurfacing of old roads to carry the modern traffic, vitrified brick, portland cement concrete, asphaltic concrete, asphaltic macadam, heavy and light asphaltic oils and refined tars, with covering materials, and oils and tars as dust preventives have merit and value. The opinion of the material man and the taxpayer inexperienced in road work should not, however, govern in the selection of materials. The oils, tars and asphalts, on account of their low first cost and availability, are more generally used for the top finish.

In the treatment with light oils and refined tars the roadbed should first be properly shaped. The surface should be free from dust and the oil or tar applied at the rate of one-sixth of a gallon to the square yard, making several applications and allowing each one to set thoroly. This treatment is recommended where the mileage is large and the funds are limited and where there is much pleasure auto traffic. No permanent results are obtained, but the mineral dust is held on the road, which reduces the wear from abrasion and eliminates the dust nuisance. This method of surface treatment is popular on account of the low first cost. The oil or tar is applied cold and in such a small quantity to the square yard that no covering material is required. It is not objectionable to the traveling public. Some oils act as lubricants to the road metal, prevent the mixing of stone dust with the water when making repairs, which is an objectionable feature in maintenance work. The oil should be semi-asphaltic base product with a gravity of about 20 degrees Beaume, and the refined tar a specific gravity of about 1.07. Better results will be obtained with the oil where the road surface is a sand or flinty gravel. Where the mineral matter is limestone, refined tar will produce better results than are obtained with sand or gravel. A better and more lasting surface may be obtained when the heavier oils and tars are used. However, a covering of sharp sand, gravel or stone chips is necessary to prevent the picking up of the bitumen. In the use of the heavy oils and tars it is necessary to have a compact road surface and not to apply an excess of oil or tar.

Asphaltic cement, heavy oils and refined tars are generally preferable to the lighter products in the resurfacing of old roads. To obtain satisfactory results from their use, experience and attention to details are necessary. A road surface that carries an excess of stone screenings or dust cemented in thin layers will be a failure as the bituminous mat or carpet will break up or peel off. The road surface should be compact and free from an excess of dust. In using asphaltic oils the larger stone in the roadbed should be exposed and the surface slightly pitted so as to obtain a mechanical bond. This pitting is best accomplished by sweeping the road surface. It is desirable to sprinkle the road with water in advance of the application of heavy asphaltic oils, as the water moistens the dust on the stone that is not removed by sweeping and assists in producing a bond between the old and new surfaces. In the use of refined tars a dry surface is necessary. The spreading of the stone chips immediately following the application of oil or tar is an important detail. It will prevent an excess of oil or tar on the edges and quarters of the road and if not given sufficient attention the surface will show "fatty" spots and be corrugated. Stone chips passing the ½-inch mesh and free from dust give the best results. An excess of stone dust will destroy the life of the oil or tar. The oil used should have a gravity from 10 degrees to 16 degrees B., and the refined tar a gravity 1.06 to 1.20, depending on material used and the method of construction.

An improvement in the resurfacing of old roads over a single application of bitumen is to apply two treatments, using a light product as a priming coat and a heavier product as a binder. The light material acts as a penetrant which ties or bonds the bituminous mat to the old road surface. Refined tars do not always run uniformly. They are more readily af-

WEST LAUREL STREET, *Fort Worth, Tex., an asphalt macadam street constructed by the penetration method under Travilla's Class AA specifications.*

WEATHERFORD PIKE, *a main county road of asphalt macadam, eighteen feet wide, constructed by the penetration method under Travilla's Class A specifications.*

fected by atmospheric conditions than the asphaltic cements and heavy oils. Examination of road work where refined tars have been used as the binder shows the lighter oils to have volatilized and the road metal to be badly raveled. On the other hand, tar concrete used for foundation in street paving is in good condition after having been down more than thirty years.

From experiments of others and his own experiences, Mr. Travilla recommends for surface treatment two applications. First, a light coat of refined tar, followed by an application of asphaltic cement. Before applying the asphaltic cement allow the tar to set for twenty-four to forty-eight hours. The stone for two-application work should be graded from that passing 1 inch mesh down to dust. This method of resurfacing will prove satisfactory on roads and residential streets where there is not too much steel-tired traffic. The cost for a 1-inch topping will approximate 25 to 30 cents per square yard.

Where the traffic conditions justify resurfacing with material to a depth of two to four inches, asphalt macadam penetration methods are recommended. Mr. Travilla has built successfully many miles of this class of construction in Tarrant county, Texas, and considers it an important factor in road work. For the base of this construction, the old roadbed is used. Gravel or a soft limestone for a depth of four to six inches after compression may be used. For the wearing surface two to four inches of hard limestone or trap rock are used, depending upon cost, traffic and available material. The stone is graded and applied to obtain the maximum density and mechanical bond of the larger stone which is to carry the load. Refined tar is applied as a paint coat for adhesion and asphaltic cement for cohesion, binder and resiliency, using approximately two gallons to the square yard. The best results cannot be obtained by hand pouring and the use of a pressure distributer is recommended for this class of work.

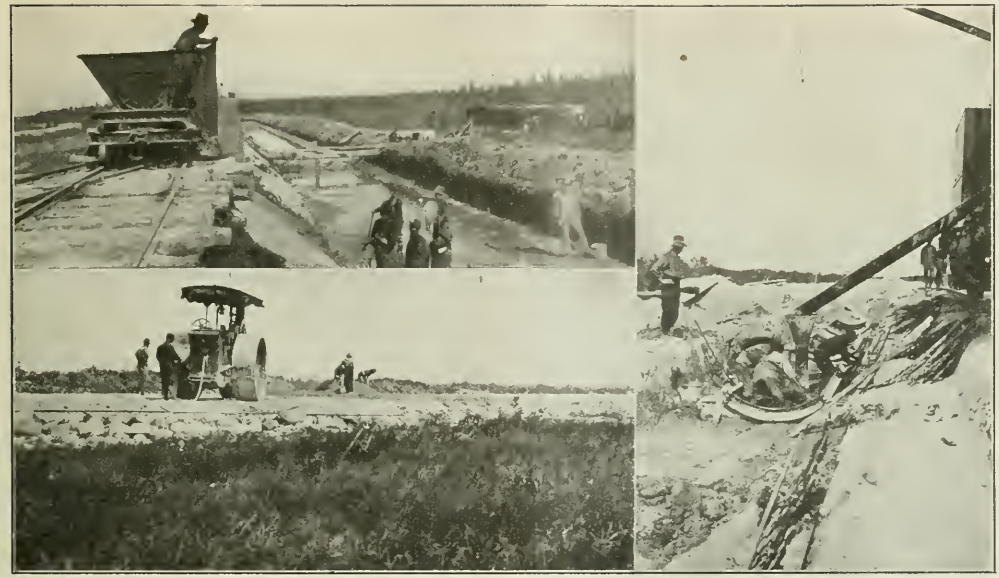
The success of the construction does not depend so much upon the per cent. of bitumen used as it does upon the uniformity in distribution, the mechanical bond of the stone and the density of the mineral aggregate. The best practice is to screen the stone into four sizes from that passing the 2½-inch mesh down to dust and apply the different sizes so as to obtain a minimum voidage. To obtain satisfactory results by this method requires the strictest attention to details. It is not unusual to hear of this method of construction being condemned and of its many failures. The poor success in numerous jobs can be attributed to nothing but inexperience on the part of the engineer.

Asphaltic concrete construction, on account of the material entering into it being carefully determined in advance, has proven a satisfactory method of construction, and specifications can be prepared and followed better with this method of construction than with those heretofore spoken of but, owing to the greatly increased cost, such construction should be restricted to business streets and heavily traveled residential streets.

Many failures are attributed to the use of bitumen in highway construction, but as such a small per cent. is used in making up a roadway surface, undoubtedly most of the failures investigated are caused by the lack of experience and attention to the details with the mineral aggregate which composes 90 per cent. of the wearing surface.

Mr. Travilla spent in Tarrant county, Texas, in 1913 to 1915, about $900,000 on highway surfaces, including about 100 miles of broken stone roads and 35 miles of gravel. The broken stone roads are of two classes, asphalt macadam and water-bound macadam, using hard limestone and the methods of construction above described. The choice of the class and width of road for any line was based on a traffic census, showing number, kind and weight. The macadam roads have gravel shoulders, so that no such road has a usable width of less than 16 feet.

DELIVERING ROAD CONSTRUCTION MATERIAL BY MOTOR TRUCKS.



ABOVE—FILLING WITH SAND AND GRAVEL THE CONDUIT TRENCH, WHICH HAS BEEN EXCAVATED THRU THE SOFT MARSH TO SOLID GROUND BELOW AND MUST BE REFILLED WITH SOLID MATERIAL TO THE GRADE LINE. BELOW—COMPACTING A FOUNDATION FOR THE CONDUIT, WHICH IS SLIGHTLY ABOVE THE NATURAL GROUND LEVEL. RIGHT—PLACING FORMS FOR INVERT OF CIRCULAR REINFORCED CONCRETE SECTION OF CONDUIT NEAR BROKENHEAD RIVER CROSSING, WHERE IT MAY BE UNDER A HEAD OF TEN FEET.

CONDUIT CONSTRUCTION

FOR THE GREATER WINNIPEG WATER DISTRICT

Winnipeg, Manitoba, is bringing its new water supply from one of the lakes connecting with the Lake of the Woods, because the water of this small lake is more satisfactory for a city supply and is a little nearer the city than the main lake. The aqueduct, composed of concrete conduit and iron and steel pipe lines, is nearly a hundred miles long. The general features of the plans for the new works are given as an introduction, followed by a description of some of the practical details of the work of constructing the concrete conduit, more particularly the reinforced concrete portions. The methods of handling materials are of particular interest.

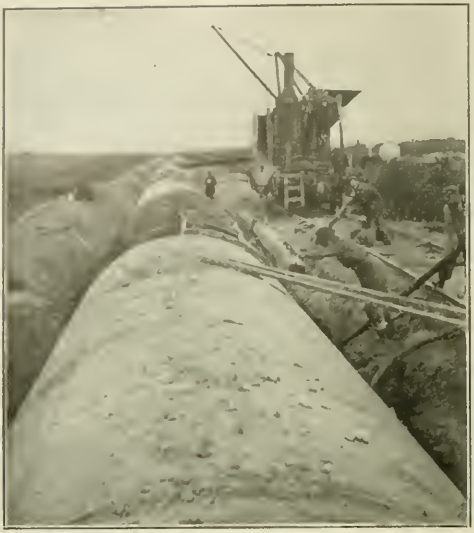
OWING to the rapidly increasing growth of Winnipeg in the last few years the well system now in operation has for some time been considered inadequate for the future demands of the city, not only on account of increasing demand, but also because of the extreme hardness of the water.

In 1913 the Greater Winnipeg Water District was incorporated comprising the city of Winnipeg, the city of St. Boniface and all or portions of five other municipalities surrounding the city of Winnipeg. The object of the corporation is the supplying of water from any permanent source whether within or without the province for the use of the inhabitants of said district for all purposes.

A board of consulting engineers was appointed to make investigation as to the most suitable means of securing a permanent source of supply, and after exhaustive study of the problem, Shoal Lake, a branch of Lake of the Woods, was chosen as being the most feasible. A practically inexhaustible supply of water can be obtained by a gravity line about one hundred miles in length from this source. The estimate of cost of this work was approximately $13,500,000 for a supply of 85,000,000 imperial gallons daily, which appropriation was authorized by the board and by a vote of citizens of Winnipeg.

The administration of the district is handled by a permanent board consisting of the mayor of the city of Winnipeg as chairman and the mayors and reeves of the various other municipalities of the district. S. H. Reynolds (chairman) and J. H. Ashdown are commissioners whose duties are the managing of the undertaking. W. G. Chace is chief engineer and James H. Fuertes of New York is consulting engineer for the project.

The main engineering features of the system, which is some 97 miles in length, comprise a construction railway with 102 miles of track, including nine sidings, spurs to gravel pits, yards and so forth; a dyke in Indian Bay and a channel for the diversion of the brown waters of Falcon River into Snowshoe Bay; a concrete cut-and-cover gravity aqueduct with appurtenant works 85 miles in length from the intake at Indian Bay to a site chosen for a future 250,000,000-gallon reservoir, southeast of Transcona; 9.8 miles of 60-inch steel pipe between this reservoir and the Red River, a tunnel under the



PLACING OUTSIDE FORMS *in foreground with traveling derrick. The concrete mixing plant is seen on the track, ready to deposit concrete thru chute into the outside forms when all in place.*

Red River, 2.3 miles of 48-inch cast-iron pipe between the Red River and McPhillips street reservoir (the city reservoir now in use). The difference in elevation between Shoal Lake and Winnipeg is approximately 300 feet; the location chosen for the aqueduct distributes this head in a remarkably uniform manner along its entire length.

In the fall of 1913 active work was begun and survey parties were put into the field to find the most economical line. At the same time the designing of the aqueduct was in progress to discover the types of construction most suitable and grades proper for the conditions of the country thru which the line passes, which country contains numerous large muskegs. The work progressed favorably and in the spring of 1914 the final location was established and the contract was let for clearing the right of way, which varies from 300 to 500 feet in width. A large part of this right of way was obtained by grants from the Dominion government.

The year 1914 was spent in building a standard-gage railroad along the south margin of the right of way between Shoal Lake and Winnipeg and also in building the dyke across Indian Bay. This dyke is approximately 7,000 feet long and contains about 230,000 yards of material. A large number of drainage and offtake ditches were necessary in order to drain the right of way properly before actual construction of the aqueduct was commenced. Railway water tanks, miscellaneous railway buildings and engineers' quarters were built. Contracts for the aqueduct proper were let during 1914.

In the spring of 1915 the aqueduct construction commenced and this will be pushed forward with all possible speed until final completion, which is expected in the fall of 1918. For the work contracts were let in five sections to local contractors and at satisfactory unit prices.

The sand and gravel for the concrete is furnished by the district from its own gravel pits. All of the material is first passed thru a screening plant and assorted as to the various sizes and then remixed into suitable proportions so as to make the strongest and most watertight concrete available.

When this work is completed the Greater Winnipeg Water District will have a water supply system of permanent character, which will supply a very high quality of water in abundance for years to come, or until the population reaches about 1,000,000. When these requirements are exceeded, the quantity as supplied by gravity may be greatly increased by pumping, prior to the installation of a second aqueduct.

The conduit of the Greater Winnipeg Water District is some 95 miles long, and nearly 85 miles of it is of concrete, much of it of the horseshoe section shown in one of the accompanying photographs, being all that part in which the conduit follows the hydraulic grade line.

At the lower end, some five miles of the conduit is of reinforced concrete circular section, as it may be under an internal pressure due to some 20 feet depth of water in the reservoir into which it is to discharge. At the crossing of Brokenhead river there is about 2½ miles of circular reinforced concrete conduit which may be under a head of about 10 feet, as the conduit drops about that distance below the hydraulic line. The size of the conduit varies from 5.1 feet diameter circular to 9 feet by 10 feet horse-shoe section according to the slope of the hydraulic grade line and the conduit at various points. The grade line is not a straight line but follows the slope of the ground surface, always running down, with the exception of the river crossing mentioned.

The accompanying photographs show the nature of work done in 1915. Much of the area thru which the aqueduct travels is the so-called muskeg, 8 or 10 feet deep, full of water and practically impassable except when frozen. The conduit is ordinarily laid in a trench 3 or 4 feet deep, so that its crown projects several feet above the surface and it is covered with earth to a depth of 4 feet above the crown, thus making an embankment up to 8 feet high or so and 8 feet wide on top.

HANDLING FORMS BY TRAVELER, *as done on three contracts. The concrete, mixed in a central plant, is delivered from cars by the railroad on the side of the trench, thru chutes into the forms.*

COMPLETED SECTION *of plain concrete conduit, horseshoe form of section, where there is no internal water pressure. Note wooden strip water stop imbedded in the surface of the invert side of the joint between invert and arch; also the copper strip around the arch to prevent leakage thru the expansion joint provided at this point.*

The first of the photographs shows the trench thru the muskeg, which is draining itself. When necessary to remove soft material, the trench is dug below the flow line of the aqueduct and then filled up to that level with sand and gravel dumped into the water and the water is then drained out. This process thoroly settles the filling and makes a solid foundation for the conduit.

In the second photograph is shown a foundation at or slightly above the ground surface, made of clayey gravel compacted with a 14-ton roller in 4-inch layers. The large stones seen have been rejected and thrown out by hand. The pipe line seen along the row of stones is used for moistening the gravel and supplying the boiler.

The third photograph shows the laying of the invert of the reinforced concrete circular section under 10 feet pressure near the Brokenhead river crossing. The completed invert with projecting reinforcement ready for the arch forms is seen in the left foreground. Men are placing Blaw forms for invert construction farther back and the reinforcing bars, car containing concrete mixer, concrete chute and hopper are seen in place ready for work on the right of the trench.

The fourth photograph shows this circular reinforced section in various stages of progress. In the background at the right is the railroad built in 1914 by the district to deliver material to the work. It is standard gage and, including sidings, is 102 miles long. The telegraph poles, whistle post and portable cement storage shed show its position relative to the aqueduct.

The gravel and cement delivered by the railroad are picked up by a traveling derrick with a 65-foot boom and discharged into the concrete mixing plant on the car seen in the middle ground. This derrick is just out of sight on the right and is placing outside forms in the foreground, only the fall and a section of the form showing, with the men guiding it to place.

The concrete mixing plant is equipped with a water tank and a ⅝-yard Milwaukee chain-belt mixer and a spout with derrick to handle it and deliver concrete to the forms as shown. On the bank at the left is a pump, used to keep the trench dry.

The fifth photograph shows a method of handling forms and concrete in use on three contracts. In each of these cases a central mixing plant was established with platforms for receiving aggregates, cement shed and concrete mixer, located close to the district railroad track. A narrow-gage industrial railway was located on the spoil bank of the trench excavation, as seen on the left in the picture. On one contract a 3-ton gasoline locomotive hauled the concrete cars from the mixer to chutes opposite the forms to be filled. Outside forms were handled by the traveler, seen over the conduit on the right, which ran on the rails also shown in the photograph. The inside forms were handled on all contracts by special carriage running on tracks laid on the invert.

The sixth photograph shows the cross section of the completed conduit of horse-shoe form. The track for handling inside forms is seen on the invert. The ridge on the surface of the joint to be made between invert and arch, seen on the left, is a wooden stop-water, consisting of a strip of well-seasoned ¾ by 1½-inch white pine dressed on both sides. It forms a seal to prevent percolation along the horizontal joints where arch and invert meet. The end of the section of conduit shown is prepared for use as an expansion joint. It shows a copper strip used as a water-stop, consisting of a sheet of 20-gage copper 6 inches wide, extending the full length of the joint. It is bent along the center line to form a ½-inch offset exactly at the joint between the adjacent concrete faces. Chief Engineer W. G. Chace is standing in the foreground.

The seventh photograph shows the complete aqueduct in the foreground and a drag-line scraper in the rear back-filling over it. The machine proved very efficient for this work as well as for excavating the soft material which overlay the firm material on which the aqueduct was laid. On one contract teams and a walking dredge were used for excavation. On another, ⅝-yard revolving Thew shovels were used.

Chief Engineer W. G. Chace has been very courteous in supplying information and the photographs illustrating this article.

MAKING THE EMBANKMENT *which covers the conduit at least four feet deep. The drag-line excavator used on some of the contracts was very successful in this sort of work.*

COMPARATIVE RAINFALL RECORDS USED IN DESIGNING SEWERS AND DRAINS

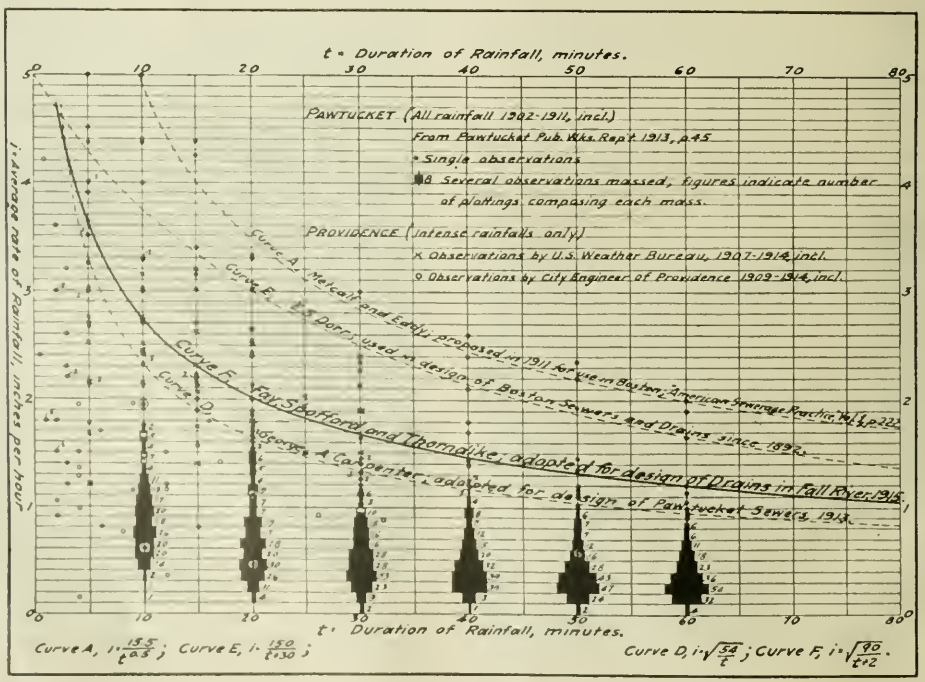
IN connection with the exhaustive study made by Fay, Spofford & Thorndike, consulting engineers of Boston, for the Watuppa Ponds and Quequechan River Commission of Fall River, Mass., an investigation was made of the rainfall.

In designing the surface-water drains, it was necessary to estimate the maximum rate of precipitation lasting long enough to produce the greatest rate of run-off. For the determination of these rates, the records of the ordinary type of rain gage are of no value, for these tell only the amount falling per day, or the total amount which falls in a given storm. Intensity of precipitation can be obtained only from the continuous records of automatic rain gages which record the duration as well as the amount of precipitation. Such gages are comparatively few in number and, there being none in Fall River, it was necessary for the determination of the intensity of rainfall to make use of records obtained from other nearby places similarly situated. A few such records were obtained from the city of Providence, both from the United States Weather Bureau there and from the city engineer's office. From Pawtucket, R. I., a large number of records of a high degree of accuracy were obtained from George A. Carpenter, city engineer. The data thus obtained have been recorded upon the accompanying diagram, and with reference to these data, four curves have been plotted, showing the intensity of rainfall lasting thruout any given interval for which provision may reasonably be made. Curve A shows the maximum intensity of rainfall for any given period of time, which Metcalf and Eddy, consulting engineers, recommended in 1911 to govern the design of sewers for the city of Boston ("American Sewerage Practice," Vol. I, p. 222). This curve lies above the intensity of practically every rainfall of which there is record in Boston.

The intensity of curve E was prepared by Edgar S. Dorr, C. E., formerly engineer in charge of the sewer system of the city of Boston, and has been used in the design of Boston sewers and drains since 1892.

Curve D is that prepared by Mr. Carpenter, and used in the design of the Pawtucket sewers.

Curve F is the one adopted by the consulting engineers as the basis of the design of the surface-water drains for Fall River. Curve F may be represented by the equation: The intensity of precipitation in inches per hour is equal to the square root of the quotient obtained by dividing 90 by the sum of the constant 2 and the time in minutes during which the rainfall of this intensity lasts in the case of any given storm for which it is proposed to make provision in the storm drains of Fall River. It does not give the maximum rates of rainfall which may be expected ever to occur, or which are known to have occurred in the past, because drains designed for such rare and extreme conditions would be enormously expensive, and the excessive cost would not be justified in a city like Fall River. On the rare occasions when rain falls to a greater intensity than the drains can accommodate, a small amount of surplus water will run off over the surface of the ground, just as nearly all of it does at present, or it will stand in the gutters until the rainfall decreases, when the drains can dispose of it. The larger the city and the more closely it is built up, the greater should be the provision made in the drains for the disposal of surface water. For this reason, the two curves for use in the city of Boston lie above those shown for Fall River and Pawtucket.


t = Duration of Rainfall, minutes.
i = Average rate of Rainfall, inches per hour
PAWTUCKET (All rainfall 1902-1911, incl.)
From Pawtucket Pub. Wks. Rep't 1913, p.45
Single observations
8 Several observations massed, figures indicate number of plottings composing each mass.
PROVIDENCE (Intense rainfalls only)
X Observations by U.S. Weather Bureau, 1907-1914, incl.
o Observations by City Engineer of Providence 1909-1914, incl.
Curve A, Metcalf and Eddy proposed in 1911 for use in Boston, American Sewerage Practice, Vol. I, p. 222
Curve E, by Dorr, used in design of Boston Sewers and Drains since 1892.
Curve F, by Stafford and Thorndike, adopted for design of Drains in Fall River, 1915.
Curve D, by Carpenter, adopted for design of Pawtucket Sewers, 1913.
Curve A, $i=\frac{13.5}{t+3}$; Curve E, $i=\frac{120}{t+30}$;
Curve D, $i=\sqrt{\frac{54}{t}}$; Curve F, $i=\sqrt{\frac{90}{t+2}}$.

QUESTION DEPARTMENT

Danger of Pollution of Water Supply from Population on Reservoir Shores

The enclosed copy of correspondence between the Civic Association of Fort Worth and the United States Public Health Service is self-explanatory. The principal question involved is whether rapid filtration of a water supply thru sand, preceded by coagulation, may be relied upon to remove any pollution caused by using the immediate vicinity of the reservoir as a public park.

This bureau has been asked to prepare a municipal exhibit to be shown in Austin and Fort Worth next February, and interested people have requested us to emphasize, by means of charts, the danger to public health that would result from such action as the city has contemplated. Can you, from your experience and wide information on current improvement problems, put us in touch with any actual cases of such pollution that we might present in charts?

EDWARD T. PAXTON,
Bureau of Municipal Research and Reference,
University of Texas, Austin, Tex.

Following is a letter to Dr. Allen J. McLaughlin, U. S. Public Health Service, Washington, D. C., from Mrs. Charles Scheuber, chairman of the civic committee of the Federation of Women's Clubs, making a statement of the problems involved:

I am writing in behalf of the Federation of Women's Clubs to ask your assistance in the solution of a question of the gravest importance to the people of Fort Worth. As you doubtless know, Fort Worth is one of the rapidly growing cities of Texas with a population of 92,352. For the past twelve years the city has been supplied with water from an artesian system of water works owned by the municipality. As the city has grown the cost of operating the system has increased, owing to the greater depth from which the water has to be raised, to such an extent that the operation of the water works has been an enormous burden, in spite of the fact that the price of the water has increased to thirty cents a thousand gallons. Three years ago the city authorities were forced to the conclusion that they would have to find a cheaper water supply. Fort Worth has in its immediate vicinity several excellent sites for a surface supply of water by the construction of a dam. A site nine miles from Fort Worth on the West fork of the Trinity river was chosen, on which was constructed a dam covering three thousand six hundred acres of land and impounding 31,000,000,000 gallons of water. The dam has just been completed. This water is to be brought to Fort Worth by gravitation thru a closed conduit line and filtered by rapid coagulation thru the sand before it is turned into the water mains. Thru bad management, the conduit line has not been completed, and probably will not be in operation for a year. In the interval the dam is full to overflowing. The creation of a splendid body of water within nine miles of the city in this waterless section of Texas has at once aroused the feeling that here is a splendid opportunity for our people to enjoy boating, fishing and hunting. I have forgotten to state that to protect the dam the city has acquired about its shores two thousand four hundred acres of additional land in which many of our citizens see an opportunity for the city to reimburse itself for a portion of the outlay of $1,500,000 for the new water system by the sale of lots to citizens for country homes, etc.

The members of the Federation of Women's Clubs have been studying for some months the question of a surface supply of water. The object of the study was to assist in overcoming the deep antipathy of a great portion of our citizens to a surface supply of water on the ground that it is not pure, nor can it be rendered entirely safe by any system of filtration. As they studied the subject they were convinced that a surface supply of water can only be rendered safe by the utmost vigilance, and that the main requisite is to keep the source of supply pure. Therefore, they were astounded when they learned that the City Commisioners were going to consider the question of permitting the citizens to place boats on the dam, and that the question of selling the land on the shores of the dam for building sites was being seriously considered. They at once prepared the petition, a copy of which I enclose, and got the Board of Health to also file a protest. Final action on the question was postponed, and in the interval the city attorney was instructed to prepare the ordinance governing the use of the dam in acordance with the protests, the ordinance to be re-submitted to the Board of Commissioners when drawn. The protests of the Board of Health and Federation of Women's Clubs are being ridiculed on the grounds that the West Fork drains 2,000 square miles of territory on which are the following towns: Springtown, 24 miles from Fort Worth, population 350; Decatur, 36 miles, population 1,651; Bridgeport, 40 miles, population 2,000; Jacksboro, 56 miles, population 1,480; the density of population on watershed including towns is from 18 to 45 per square mile; that Decatur, Bridgeport and Jacksboro empty their sewage into the West Fork, and, therefore, it is worse than absurd to protest against the shores of the dam passing into private ownership, and to suggest that the dam be patrolled and people only be permitted to drive thru; that if the filtering plant can purify the water from the contamination which the city cannot control, it can also remove the additional deleterious matter that would be injected into it by the use of it for boating, hunting and fishing purposes, and by the sale of the land for a hotel site and residential purposes. The federation's stand is that a body of water as large as Worth Dam will not purify itself measurable from the uncontrollable contamination, and that instead of adding deleterious matter, every effort should be made to control the source of possible contamination, and that the possible contamination from using the shores of the dam for residential and camping purposes is very much greater than the sewage from Decatur, 36 miles away. We believe that a surface supply of water can only be made safe by eternal vigilance, and that not any city has any right to take the slightest chance in anything which so intimately affects the health of the people as a water supply. We also believe that it is most fortunate that the conduit line is not finished, since, while the dam was under construction for a period of two years, several hundred men were camped on the site of the dam without the slightest sanitary precautions having been taken; therefore, we feel that it is well that there will be this interval before the water can be used, to permit it to purify itself. Our authorities, if anything, should err on the side of caution if they desire the people to use the water, for, as a rule, the people are afraid of a surface supply of water, and, rather than use a water they are afraid of, will burden themselves by purchasing artesian water from privately owned wells for domestic purposes. But of course the only object of the members of the Federation of Women's Clubs is to serve the best interest of the people, and if they are mistaken in the stand they have taken, and the dam can be used for hunting, boating and fishing, and the land for

camping and residential purposes, they will be very happy to recede from their position.

I hope you will be able to help us by frankly stating just what you think would be the best plan for the Board of City Commissioners to pursue to protect the interest of the people of Fort Worth. I trust you will pardon me for troubling you with all this detail.

Following is Dr. McLaughlin's reply:

I have some hesitancy in rendering an opinion upon a special problem existing hundreds of miles away, but on points of general policy in safeguarding water supplies raised in your letter, I am very glad to give my humble opinion.

In spite of the fact that a purification plant is provided, all avoidable pollution should be kept out of the source of supply. The degree of purity of the raw water regulates your margin of safety, and this priceless margin of safety should not be thrown away for the financial advantage of some real estate exploitation.

I enclose a paper submitted by me to the International Joint commission for their information upon what constitutes a safe drinking water.

This paper brings out the limitations and fallibility of even the best filter plants, and the necessity of a decent margin of safety.

The results of placing an unreasonable burden or responsibility upon a filter plant are brought out also.

It is bad enough to be compelled by circumstances to struggle with a bad raw water, but to deliberately permit a good source to become a dangerous one is unpardonable.

Your letter is so sane and sound that I have little to add, except to advise you stick to your guns. If such an unthinkable result as losing your fight should follow, be careful to fix the responsibility for ruining your water supply squarely on the shoulders of the guilty parties. They must assume the responsibility of the passive murder which will follow the placing of an unreasonable burden upon your filter plant.

The same question arose many years ago with reference to the water supply of Rochester, New York, taken from Hemlock Lake, a larger body of water than Worth Lake, a natural lake and quite deep. The lake is a summer resort for Rochester people. There was soon much complaint of the liability of pollution of the water supply by the drainage from the cottages, boarding houses, hotels and restaurants on the banks of the lake and even over the water. Since the expense of the purchase of the land bordering the lake was prohibitive, the aid of the State Board of Health was sought and rules for the government of the watershed of the lake were established. These required that all human excreta and dangerous matter, including garbage and refuse, should be deposited in water-tight receptacles and that earth closets should be used in place of water closets, the apparatus to be supplied by the owners of the property. The city of Rochester was required to collect all this refuse at regular intervals and keep a boat running during the time the lake was not frozen, which takes the collections and disposes of them in a safe place. The water is not filtered.

The same question arose with respect to the water shed of the Croton river, which formerly supplied all the water for what is now the boro of Manhattan, New York City, and similar rules were promulgated after a careful survey of the sources of pollution of the water and study of the methods of preventing it. The city has spent many thousands of dollars in securing the enforcement of these rules and paying expenses justly chargeable to the city in connection with the work of removing and preventing pollution. This water also is not filtered. The area of the water shed is great and the tendency toward increase in population, tho slow, is irresistible, and the filtration of the entire supply is now proposed as an additional precaution to remove the small but slowly increasing amount of pollution now reaching the water.

It is true that many cities depend upon filtration to remove pollution from river water supplies and lake supplies, but the writer is not acquainted with any city which has deliberately added pollution to its water supply beyond that which it normally contains. On the other hand, cities are frequently changing their sources of water supply when the existing sources become polluted beyond a safe limit, or are adding the most efficient filtration and treatment plants obtainable.

No sanitary engineer would recommend the plan of populating the shores of the lake, particularly if the property is sold and the control of the situation passes from the city, even tho he must admit that the best modern methods of treatment of water are extremely efficient in removing such pollution, because there is always the danger of a break-down or a leak or of careless or malicious mis-management of the plant which would result in a serious epidemic of disease in the city, and the engineer is unwilling to take the responsibility for the consequences of such a break-down or failure of the system.

The reports of the State Boards of Health of Massachusetts, New York, Ohio and Pennsylvania in particular, and of several other states in less degree, have data regarding such sources of pollution and their effect, which could be put into graphic form to show what the dangers are. The work of the Massachusetts Board runs back over thirty years, that of New York for about thirty years, and that of Ohio for some twenty years. There are also some special studies of Chicago, Cleveland, Cincinnati, Louisville, St. Louis and other water supplies, of the Illinois, Mohawk, Hudson, Allegheny, Ohio, Mississippi and other rivers which would be of interest.

Can any of our readers point out a specific instance similar to the subject of this inquiry?

Resurfacing Old Brick Street with Asphalt

There is a brick paved street, 20 years old, here, that needs re-paving and a controversy has arisen whether it can be resurfaced without disturbing the old brick pavement with a sheet asphalt pavement. Eighty to ninety per cent. of the old pavement is out. The rest represents holes and depressions. Has not this resurfacing been tried in the west, particularly, viz., Toledo, Columbus, Cleveland, and Detroit with success? I can reach a file of the Magazine in the library.

M., ———, N. J.

An early article in MUNICIPAL ENGINEERING, giving details of the method of resurfacing a brick street in Decatur, Ill., with asphalt, will be found in vol. xxiii, p. 77. Portions of Sheridan boulevard, Chicago, Ill., originally paved with brick and with macadam ,were resurfaced with asphalt, as noted in vol. xxxv, p. 111. Resurfacing of old granite block streets in the boro of Manhattan, New York, of macadam in the boro of Brooklyn, and of brick in Bloomington, Ill., is referred to in vol. xxxiv, p. 361, where some of the difficulties in the process are suggested. The method used in St. Joseph, Mo., in resurfacing brick streets with asphalt, is given in vol. xliv, p. 153; in Memphis, vol. xlv, p. 104. A method of surfacing both old and new brick streets with a thin coating of asphaltic materials, as used in Minneapolis, Minn., is given in vol. xliv, p. 336. The details of the method of resurfacing macadam streets with asphalt, used in Chicago, Ill., are given in an illustrated article in vol. xlvii, p. 263. The new fibered asphalt pavement is described briefly in vol. xlvii, p. 234, and more in detail in an illustrated article in vol. xlviii, p. 292. An old brick street in Charleston, W. Va., has been resurfaced with fibered asphalt since the date of that article and is reported to be very satisfactory.

Will our readers give further references to both successful and unsuccessful jobs of resurfacing old pavements with new asphaltic tops of any kind?

WORKERS IN THE FIELD

A Trench Tamper or a Soldier

The Editor of MUNICIPAL ENGINEERING:

Sir—We are sending herewith cartoon as appeared in the *Ohio State Journal* under the caption: "From Out My Window." We are pleased to note that the cartoonist obtained his inspiration from some contracting job and not from work done by this department, as we use mechanical tampers as described in our article which recently appeared in your valued publication.

Herewith we are enclosing photo showing our "P. & H." tamper at work. This machine does the work of sixteen men and it never tires, stops to converse or "soldiers" on the job.

W. A. KELLOGG,
General Foreman of Water Works, Columbus, O.

A TRENCH TAMPER THAT DOES NOT SOLDIER.

Electrolytic Sewage Treatment in Boro of Queens, New York City

The Editor of MUNICIPAL ENGINEERING:

Sir—An article on the "Treatment of Sewage with Electricity and Lime," appearing in December number of MUNICIPAL ENGINEERING, has come to my attention. There are certain statements made in this article which easily may result in decidedly wrong conclusions being drawn by readers not familiar with actual conditions.

The first statement to which I take exception is that "as a result of the favorable results in the small plant" these further experiments were conducted. About a year ago, while connected with the New York Bureau of Municipal Research, I conducted a series of tests made on the small test unit installed by Mr. Landreth at Elmhurst. These tests were conducted in co-operation with the Bureau of Sewer Plan of the Board of Estimate and followed the presentation of a report by Mr. Travis and Dr. Firth, of the boro of Queens, to the Board of Estimate, together with a request from the boro president for funds to install a plant of this type at Elmhurst.

While the Bureau of Sewer Plan, so far as I know, has never made a public report of these tests, the New York Bureau presented a report of its findings to the Bureau of Sewer Plan,

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CARTOON *appearing in Ohio State Journal, Columbus, O., referred to in letter from Mr. W. A. Kellogg, general foreman, Columbus water works, Columbus, O.*

SNAP SHOTS OF A STOMPER IN EAST BROAD ST.
FEARING TO HURT THE DAT HE STOMPS VERY TENDERLY
LOOKS AROUND TO SEE IF THE BOSS IS NEAR —
BOSS NOT IN SIGHT SO RESTS ABOUT FIVE MINUTES
DECIDES TO TAKE A CHEW
BOSS SUDDENLY APPEARS ON SCENE
EASES UP ON THE STRENUOUS AS THE BOSS PASSES BY
WATCHES TRANSPARENT PUMMY BREEZE ALONG FROM HIGH ST TO OUT OF SIGHT
ENJOYS A LITTLE CONVERSASHE WITH THE STOMPER NEXT DOOR
THE BOSS AGAIN
DECIDES TO HAVE A SMOKE
WHISTLE

to the boro of Queens and to Mr. Landreth. Inasmuch as this report has been made public, I feel at liberty to call your attention to its contents.

In the first place, the process was condemned principally on the basis of cost, altho we were unable to prove that the electrolytic treatment produced any better results than were accomplished by treatment of the sewage with lime alone and the same amount of agitation.

Waiving, however, the question of the degree of purification attained, which, in my opinion, is, after all, of only secondary importance, the question of cost has not yet been satisfactorily answered. The costs cited in the article in question do not include two very important items. First, no account is taken of the cost of the plant. As quoted me a year ago, the price of the machine was $15,000.00 for one 1,000,000-gallon unit. Sedimentation tanks also must be included, as must a "reserve unit." Second, while the cost of pumping is included in the $65.00 cost per million gallons quoted as the operating cost of the old plant, it is not included in the estimates for cost of electrolytic treatment. Furthermore, altho I made rather an exhaustive study of the operating costs of the old plant, I cannot account for the $65.00 rate without also including interest and depreciation on the building and equipment, including one acre of sand filters, of which no mention is made in the article.

While it is true that the cost of treatment under the old conditions is of minor importance, nevertheless, unless a true comparison is made, to include all cost items, no fair statement of facts is made.

It appears that even if the cost per million gallons can be accepted as $22.28, it is still considerably higher than the cost of other treatments. The explanation made that the degree of purification is greater than is obtained from other methods does not altogether over-balance this excessive cost. It is only on rare occasions that the degree of purification which is claimed for this process need be reached. Under ordinary conditions the purification gained by treatment with the older and well-known methods is sufficient. While the "result of the operation of the electric current is different from that of the application of hypochlorites," nevertheless, if a sterile effluent is necessary the application of hypochlorites will produce the desired result. The mere statement that the results are different does not explain why the additional expense is advisable. A cost of $5.00 to $8.00 per million gallons is considerably different from a cost of $22.00 to $35.00 per million gallons, for a three-million-gallon plant.

From my acquaintance with the plant at Elmhurst and the conditions of flow, I feel sure that during these later experiments sufficient attention was not paid to the irregularity of flow and the consequent variation in the strength of sewage treated. I have on my desk a copy of the report of which your article is an abstract. The tests were made in the majority of cases in the forenoon. Experience in former tests shows that the sewage becomes very dilute after 2:30 in the afternoon and continues so until the morning sewage arrives again. It is a well-known fact that the stronger the sewage the better the comparative results of any chemical treatment which includes sedimentation.

Another point which has not been treated satisfactorily is sludge disposal. The statement is made that the sludge produced by this process is about the same as that produced by chemical precipitation. This is true in the main, providing equal quantities of lime are used in both treatments. The sludge produced by the electrolytic treatment, however, is more bulky than that produced by ordinary lime treatment. The fact that the relative stability of the sludge is greater that that of ordinary sludge does not answer the question of how the bulk is to be disposed of. Once it has been pressed or dried, it still remains to be carted away. It is my opinion that the amount of sludge produced under this treatment is somewhat greater than that produced by the lime process, but I am willing to grant that the amount may be the same, still its ultimate disposal remains a troublesome question, as always, in any plant where sedimentation is a part of the treatment.

While talking with Mr. Landreth about a year ago, he made some rather remarkable statements to the effect that this sludge could be turned directly into a stream or water shed without creating a nuisance. I was unable to convince him at the time that the greatest nuisance which could possibly arise would be the filling up of the waterway. Stability has nothing to do with the filling qualities of the material.

The statements in the article regarding the former unsatisfactory method of sludge disposal appear to be irrelevant to the subject of the report. The former methods were far from efficient. In fact, the entire plant was recognized as being antiquated and utterly unsuited to present demands. Consequently, any comparison made between the old plant and any type of new modern plant would be equally as glaring.

In closing, I feel sure that it was not the intention of MUNICIPAL ENGINEERING to cause any misconception to arise in the minds of those not fully acquainted with the facts. It is for this reason that I have taken the liberty to call your attention to some of the wrong impressions which might easily arise from a reading of this article.

JAMES W. ROUTH,
Engineer, Rochester Bureau of Municipal Research,
Rochester, N. Y.

The first article on this subject in MUNICIPAL ENGINEERING appeared in October, 1914. Attention was called in the introduction to the article, vol. xlvii, p. 279, and in an editorial on p. 287, to the lack of sufficient data as to cost. The article in the December number, vol. xlix, p. 222, contains some additional figures which evidently do not include the overhead charges and must therefore be recognized by the reader as incomplete. The statements in the above letter regarding the inaccuracy of the comparison with the old plant are very welcome.—[EDITOR.

Engineers and Military Preparedness

At its annual banquet on December 2 the Brooklyn Engineers' Club heard a discussion of military preparedness by Gen. Leonard Wood, Admiral N. R. Usher, Elmer A. Sperry, Commander Jessup and Captain Kilbourne. William Barclay Parsons announced that the committee of civil, electrical, mining, mechanical and consulting engineers, of which he is chairman, prepared a bill to submit to Congress in December providing for the creation of a reserve corps of engineers.

Calcium Chloride on Gravel Roads

The Editor of MUNICIPAL ENGINEERING:

Sir—Your letter regarding calcium chloride for the treatment of gravel roads in the vicinity of Grand Rapids has been referred to us, as we made the application on these roads, as well as on miles of gravel streets in the city.

The twenty-five miles treated for the Kent County Road Commission received one pound per square yard about the 1st of July, at a cost of 3¼ cent per yard, 9 feet wide, and are today in splendid condition, as calcium chloride draws moisture from the atmosphere and thus acts as a binder, moisture, as you know, being absolutely necessary to bind a gravel or macadam road.

The principal thorofares in the city have depended on calcium chloride for the entire season, and all such streets are now hard and in splendid condition, while those sprinkled with water are full of holes and minus the dust binder, thus leaving the gravel in a loose condition.

A COUNTRY ROAD *near the Soldiers' Home, very heavily traveled, and supposed to have been beyond redemption, as it was impossible to keep the road from being picked up by the automobiles. A treatment of calcium chloride has kept it dustless and a perfect driveway. The machine in the picture was going about twenty miles per hour when the picture was taken.*

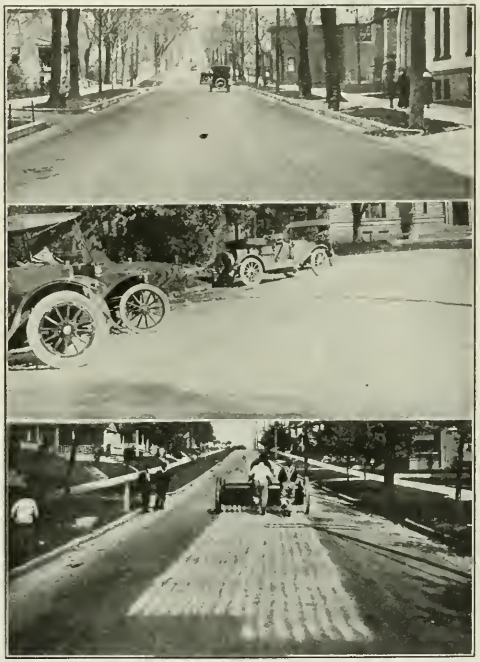
THIS STREET HAS A SIX PER CENT. GRADE. *It has had two treatments a season, and while the street was in very poor condition, calcium chloride caused the same to be packed, and kept the rains from washing the street. This was an experiment, as the heavy rains and the steep grade might have caused the calcium chloride to be washed out. The street has been recently resurfaced and given a treatment of calcium chloride, as the first proved so successful.*

THIS STREET WAS FULL OF HOLES *caused by the constant sprinkling, water standing in the low spots, keeping them mushy and continually growing larger. The street was scarified by placing four-inch spikes on a road roller, then two pounds of calcium chloride per square yard was raked into the gravel, sprinkled and rolled. This was done at a saving of* $100 *per block over the old way of hauling on 75 loads of gravel to eliminate the chuck holes, the calcium chloride making it possible to bind the old gravel. This work was done in June, has had no sprinkling since, is dustless and in a most perfect condition.*

The street repair department has also found it a great money-saver in rebuilding the gravel streets, which are full of chuck holes caused by the constant sprinkling with water, by scarifying the street and raking in about two pounds of calcium chloride to the square yard, and then rolling, which saves at least $75 per block over the old way of hauling on more gravel and clay. The streets thus repaired are the best we have in the city, and are standing the travel without any sign of wear.

While the calcium chloride applied to a street or road after it is finished is of great value, my two years' experience in making the application, both in this way and in using it in building the road, has convinced me that the best time to use the same is in building the road, which makes it hard and firm to the bottom. The calcium chloride used was furnished by the Semet-Solvay Company, Syracuse, N. Y.

We are sending you photographs of some of the roads and streets treated. WYKES-SCHROEDER COMPANY,
Grand Rapids, Mich.



THIS STREET WAS RESURFACED *three years ago with three inches of macadam, and after four weeks had lost one inch of surface, the sprinkling cart passing over same three times a day. An application of calcium chloride has kept the street dustless the entire season, thereby keeping the street from blowing away, and same has had no sprinkling cart since that time, but has been kept in perfect condition with calcium chloride treatments at an expense of one cent per square yard per season.*

THIS STREET WAS RESURFACED *with loose gravel, which traffic did not bind, and after two weeks calcium chloride was applied to one side of the street, which caused it to pack within three days. The part of the street not treated is still loose, as the photograph shows.*

THE SPREADER *used in applying calcium chloride is an ordinary lime spreader and can be purchased from any implement dealer for* $50.

LEGAL DECISIONS

Decision of Suit on Reinforced Concrete Arch Patents

As noted in the editorial department, a decision has been rendered against Luten patents on reinforced concrete arch designs. Judge Robert E. Lewis, of the U. S. district court, Colorado district, made the decision in the case of Daniel B. Luten vs. Geo. Washburn et al., based on seven of the Luten patents. It differs from prior decisions in that it draws a definite distinction between the exercise of inventive genius and the "application of mere mechanical knowledge and skill," claiming that the latter does not entitle an applicant to a patent unless it clearly involves the former. Whether the decision is right in the present case or not, this principle, if applied generally, will clear up the patent situation materially in the future at the same time that it opens the way to many mistakes of judgment in favor of and against patentees according to the circumstances of each case. Some extracts from the decision will indicate the line of reasoning followed by the court.

"On consideration of prior patents and publications introduced by the defendants to meet the separate and several claims, I am unable to rid myself of the firm belief and conclusion that each and all of complainant's claims were nonpatentable at the time he made his several applications. The prior patents as anticipations and the prior patents and publications as showing the then state of the art lead to the clear conviction that complainant in each instance only then made application of mere mechanical knowledge and skill, and that what he did is in no sense a demonstration of inventive genius. This is also the opinion of the defendants' expert witness.

"The complainant as a witness disclaims that his patents or any of them, embodied anything beyond or more than placing the steel in a new way that produces better results in a more efficient form. Now in a concrete bridge the greatest efficiency is always secured by resisting tension or pull with steel rods. That has been established for half a century; not perhaps with curved tension members, but the basic idea is very old.

"But none of complainant's patents in its specification, including drawings, and in the claims gives any specific direction as to just where any of the reinforcing members should be placed. This, I suppose, would in each instance depend upon the maximum load to be carried, the length of the spans and other elements which involve mechanics only, and would necessarily, I assume, be worked out in determining the amount of compression and tension under the established formulae in statics. In a general way, the points of greatest stress can be roughly approximated without the use of mathematical tables, but this is centuries old; that is, it is open to common observation, and the fundamental purpose of reinforcing concrete was to strengthen the structure at these points; such a discovery in Luten's day is no evidence of inventive genius.

"A bridge girder, for instance, is commonly known to be in compression on its upper side and in tension on its lower side; hence the greatest necessity for them thru the latter region, and if carried continuously thru and anchored in the outer face or foot of the abutment, it is but adding the element of suspension in bridge construction, which is old. This but illustrates. The same applies to the other points relied upon in Luten's patents.

"I see nothing more than mechanical skill in tying the wings and abutments together, the circular knee-brace, in the outer girder with a reinforcing member, binding it to the adjacent abutment and girder and in carrying the transverse member in the roadway into the outer side of the upper spandrel or girder and upward and over the longitudinal reinforcing member in that girder. In view of the Coignet letters and of the prior state of the art as evidenced by his patent, and the publications introduced as above noted, he made specific claim to a 'metallic frame-work linked or arranged so as to strengthen the same.'"

Decisions of the Higher Courts of Interest to Municipalities

STATE BOARD OF HEALTH CAN ORDER SEWERAGE SYSTEM.

While the power to tax is inherently a legislative function, which can be delegated only to municipal corporations, Acts 1914, c. 810, §§ 7, 9, authorizing the state board of health to require counties and cities to establish sewer and drainage system, is not invalid as an improper delegation of legislative authority; for it does not give the board of health authority to determine in what manner the improvements shall be paid for, but leaves that to the counties and municipalities.

The reasonableness of the exercise of the power to require the establishment of sewers and drains conferred by Act 1914, c. 810, upon the board of health is open to question and is expressly made so by section 18 of the act.—Welch et al. v. Coglan et al. County Commissioners (Baltimore Co., Md.), 94 Alt. 384.

DAMAGE FROM DEFECTIVE CURB CONSTRUCTION.

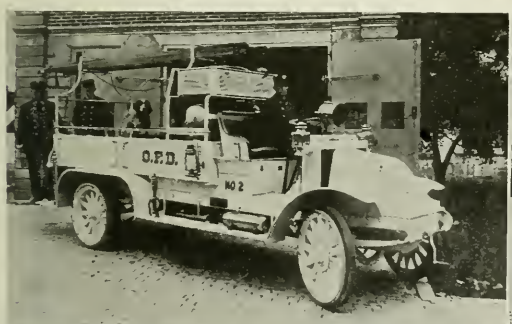
A pedestrian, stumbling over a curb curving round a corner, defective by reason of the presence of an iron band bent around the curb to protect the stone from vehicles and extending about an inch above the curb, which extended nearly six inches above the sidewalk, was not as a matter of law guilty of contributory negligence merely because he had observed the walk at other times, for where a defect is not of such a character as to show it to be so unsafe or dangerous that a prudent person in the exercise of ordinary care would not venture over it, a pedestrian in the exercise of ordinary care, who is injured in passing over it, may recover.—Bullard v. City of Independence (Mo.), 176 S. W. 1066.

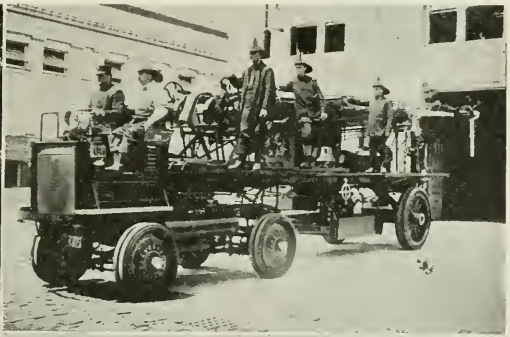
FIRE DEPARTMENT

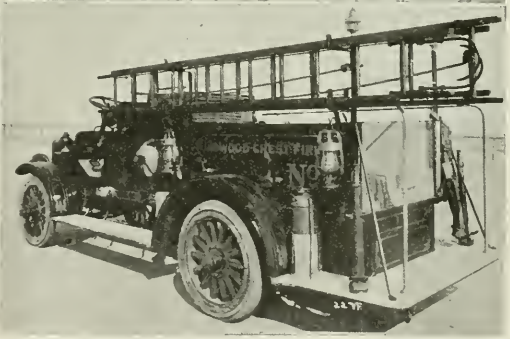
Motorization Effects Big Savings in New York Fire Department

"Seventeen thousand dollars saved in maintenance of apparatus has been set aside to buy four motor fuel wagons," states Mr. Robert Adamson, fire commissioner, city of New York. "These four motor fuel wagons will replace eleven horse-drawn wagons, releasing when in service seven more firemen, salaries $9,800 a year, and saving $15,400 in upkeep. Seventy-six new pieces of motor apparatus were added to our equipment, 27 hose wagons, 42 tractors and 7 combination hose and chemical wagons. To be able to organize twenty new fire companies and otherwise to extend the work of the department, while at the same time cutting the budget for 1915 $65,110.80 below the figures of 1914, means in itself a clear saving in administrative cost of almost half a million dollars. These changes were merely bringing the department up to date. Motorization has greatly increased the rapidity of operation of the fire companies and extended their radius of operation. It was only natural that the city should reap some advantage from the greatly-increased speed and efficiency that have come with the introduction of motor apparatus, high-pressure service and other mechanical improvements.

"On December 31, 1913, there were 1,341 horses in the department and on December 31, 1914, only 1,167. Contracts were let during the year for 76 pieces of motor apparatus to take the places of the horses retired. Forty-two pieces of

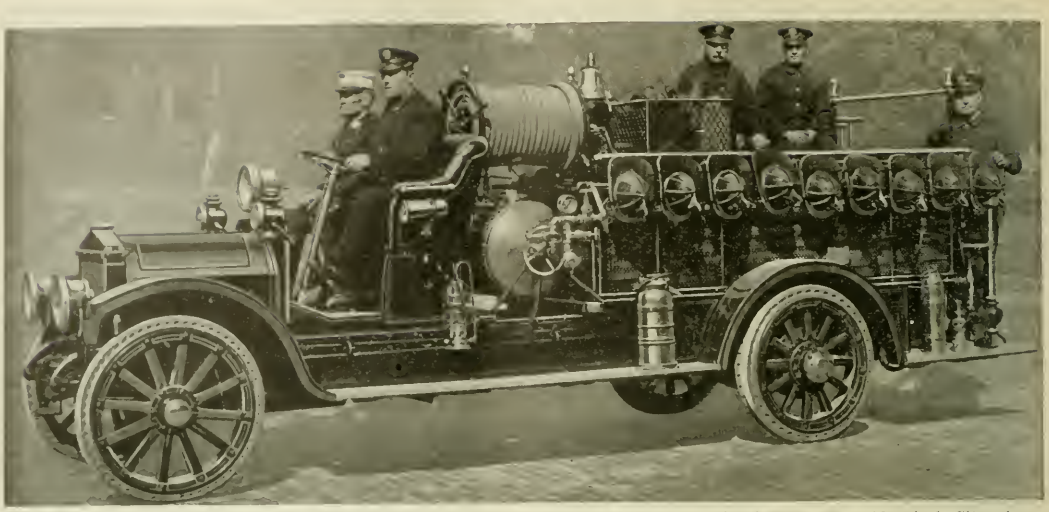






ADAMS COMBINATION, OLEAN, N. Y.
SOUTH BEND POLICE PATROL, CITY OF GARY, IND.

COUPLE-GEAR WATER TOWER, PHILADELPHIA, PA.
GRAMM-BERNSTEIN COMBINATION, WILDWOOD, N. J.



FEDERAL *Combination Hose and Chemical, City of Albany, N. Y.*

this new apparatus are tractors, each one of which represents a saving in maintenance as compared with the horse of $480 per year, $20,160 a year for all. On the 27 motor-propelled tenders installed there will be a saving in maintenance of $280 per year on each. It is recommended that sufficient funds be provided to complete the motorization of all fire apparatus by the end of 1917, according to the schedule fixed by this department.

"The purchasing division of the Bureau of Supplies and Repairs, which is under the direction of John R. Keefe, lists the following contracts awarded for motor apparatus, 1914 and 1915:

Two-wheel gasoline tractors for fire apparatus	42
Motor-driven hose wagons	27
Motor-driven combination chemical and hose wagons	7
Gasoline pumping engines	5
Total	81

Specifications Mean Gasoline Saving.

"Tho an increase of only 20 firemen was allowed for 1914, these for the fireboat Gaynor, and tho it was understood funds would be requested during the year for men for the new companies, 3 new companies were organized May 15 and December 31, last, without an additional dollar being asked for, the necessary men being procured by revocation of details and by re-location of companies, due to a careful study of the effect of motorization. Four fire companies, 5 sections and 6 small combination hose and chemical companies, shown by careful study to be no longer needed at their old locations because of motorization and changed conditions, were discontinued, thus releasing for new companies 8 captains, 8 lieutenants, 1 engineers and 93 firemen, with total salaries of $161,000 and apparatus valued at $64,000. New gasoline specifications resulted in a saving of $6,000."

Converted Water-Tower.

The Couple-Gear water tower, shown in one of the accompanying photographs, was originally hauled by horses. The forward axles and wheels were removed and the forward end placed under the fifth wheel, which is carried in the tractor frame. The tractor is a standard gas-electric type with a gear ratio of 19 to 1 in the driving wheels. Each of the wheels is equipped with dual 1x36 hard rubber tires, and each contains a double duty 3-h.p. motor. The generating outfit consists of a 5¾-inch by 6-inch stroke, 4-cylinder, 4-cycle engine, direct connected to a 13-k.w. generator. The wheel base of the tractor is approximately 100 inches, and speeds with the tower attached range up to twenty-five miles per hour.

A Gramm-Bernstein Combination Hose and Chemical

In the accompanying group of four photographs is shown a Gramm-Bernstein combination hose and chemical furnished to the city of Wildwood, N. J.

The following terse description of the combination may prove of interest: Extra heavy solid brass piping connects the chemical tank with the automatic hose reel. The piping contains 2½-inch intake connections and the valves are so arranged that water may be taken from the hydrant and be run either into chemical tank to refill it, or thru the chemical hose, or both. A pressure gage is so situated as to show the pressure in the hydrant or in the tank.

The rear axle is of the worm-driven semi-floating type. Housing is made up of one piece steel casting; axle shafts 3½ per cent. nickel steel properly heat treated.

The transmission consists of three speeds forward and reverse, selective, with gears always in mesh. Different speeds are engaged by sliding dog clutches. Direct drive on third speed. Gears and dogs and shafts are all made of chrome nickel steel. The main shaft is made up with six splines milled in the solid shaft. Gears have 1-inch face and 5 pitch. All gears and shafts operate on annular ball bearings.

This company also builds tractors and triple combinations. The triple is larger and stronger than the combination and the motor is a great deal larger, with a pump in rear of chassis to handle two and four streams.

An Adams Chemical and Hose

One of the accompanying group of four photographs shows an Adams combination chemical and hose wagon, model D chassis, in the service of the fire department of Olean, N. Y. This outfit is painted white thruout and striped in gold; all brackets and hangers are of brass.

The body is 10 feet long, 5 feet wide and 16 inches high, made of first-class hardwood, with plain panel sides, and the seat extending the full width of the body.

This truck has the following equipment: 40-gallon Champion style chemical tank; 210 feet of ¾-inch chemical hose, complete with couplings; 8-pound flat head fire ax; 8-pound pick head fire ax; crow bar, fire department style; two Ham cold-blast firemen's lanterns, brass polish; two nozzle holders, attached to rear step; extension ladder, solid side rope and pulley, rapid hoist, 25 feet long when extended, 12½ feet long when closed; prest-o-lite tank; search light, with electric starter; two brass hand rails; two oil side and tail lamps; set of tools; jack; horn locomotive whistle; speed indicator.

Low Costs Recorded by Dallas

Five machines, placed in service by the city of Dallas, Texas, November, 1913, have made a remarkable record, as follows:

Motor Truck No. 1—Total miles run per year, 4,327; average per month, 360 miles.

Motor Truck No. 2—Total miles run per year, 4,395; average per month, 366 miles.

Motor Truck No. 3—Total miles run per year, 4,133; average per month, 344 miles.

Motor Truck No. 4—Total miles run per year, 4,286; average per month, 357 miles.

The total cost of operation of these machines, including all garage expenses, gasoline, oil, grease, repair parts, extra fittings, etc., but not including depreciation on the cars, was as follows:

Motor Truck No. 1—Total expense for the year, $444.48; average cost per month, $37.04.

Motor Truck No. 2—Total expense for the year, $458.77; average cost per month, $38.23.

Motor Truck No. 3—Total expense for the year, $432.19; average cost per month, $36.01.

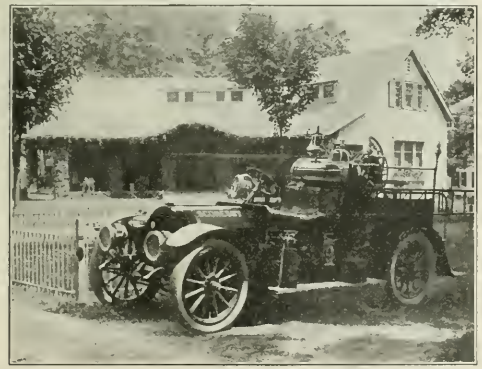
Motor Truck No. 4—Total expense for the year, $419.55; average cost per month, $34.96.

Motor Truck No. 5—Total expense for the year, $431.29; average cost per month, $35.94.

The average cost per mile, therefore, based on the foregoing and without including depreciation charges, amounted to approximately 11.5 cents.

Fire Department Notes

The Scoresby hose and hook and ladder company, of Ellenville, N. Y., have built and own the handsome club house shown in the accompanying photograph. It is the finest and most complete in the state. C. G. A. Fischer, the chief engineer of the department for the past two years, designed the chemical and hose apparatus shown in the picture and the company built it on a Kissel 50-h.p. truck chassis. Mr. Fischer has established building inspection, building laws and fire limits and reduced the fire loss more than 75 per cent. thereby. He has been in the department as fireman, foreman and chief for thirty years. The department has also three hose and one hook and ladder carts, hand-drawn.



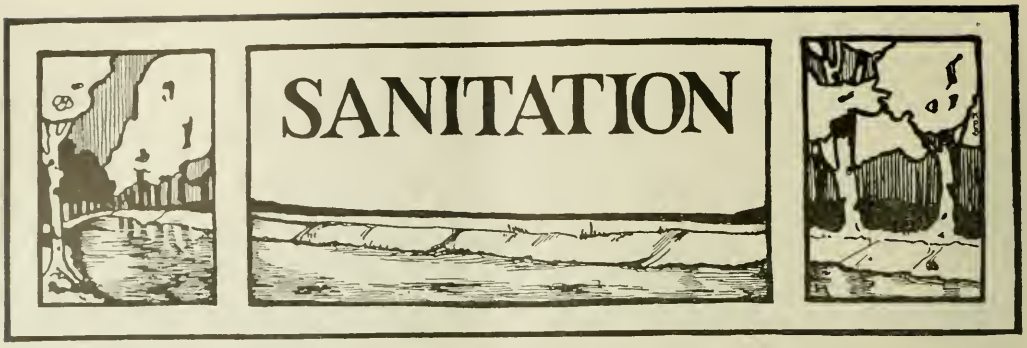
Chief Samuel G. Cottrell of the fire department of Westerly, R. I., joined the Rhode Island Ones December 20, 1868, and has held office for practically the entire period either in the company or in the district. He was elected second assistant December 20, 1873, and continued in this capacity until 1880, being placed on the honor roll October 5 of that year. Chief Cottrell was elected to the board of engineers November 5, 1890, and served till 1899, when he was elected to fill the chief executive office of the Westerly Fire Department, a position he has had the honor of holding for the past fourteen years. By his untiring efforts he has been instrumental in bringing about results that have been beneficial to the community, which has one of the largest volunteer fire departments in the state of Rhode Island.

F. J. Purdy, Assistant Chief of Fire Department at Mitchell, S. D., was injured recently by being struck below the knee with an ax while attempting to cut thru the roof of a burning building.

An elopement of a San Bernardino fireman was stopped by an alarm of fire to which his company responded. In attempting to follow in her father's automobile, the young lady set fire to the machine, causing another fire alarm, bringing the young man and his fire company to the rescue. Forgiveness and consent to the marriage followed.

W. A. McOuat, chief of the fire department of Portsmouth, O., was a railroad engineer prior to 1909, when he joined the Portsmouth fire department as captain and engineer, moving up to chief of the department in 1914. The safety fund of the city is overdrawn, so that there has not been money enough to motorize the apparatus to any extent. Chief McOuat was the head of the entertainment committee for the convention of the Ohio Fire Protection Association, held in Portsmouth last September, and the members of the association are loud in their praises of the attention paid to their pleasure and profit.

A. J. Kienle has been chief of the fire department of Easthampton, Mass., since 1906, and started it on a program of evolution which resulted in 1913 in the consolidation of the two hose companies, on account of the purchase of a White combination hose and chemical automobile truck, and a Knox-Martin tractor was bought for the hook and ladder truck. Other steps in the evolution which are still in evidence are a firemen's relief association, an inspector of wires and superintendent of the fire alarm system, civil service rules for the department, the expansion of the fire alarm system to four circuits.



The Street Cleaning Problem

By Gus H. Hanna, Commissioner of Street Cleaning, Cleveland, O., Before the International Road Congress, at Worcester, Mass.

I have been requested to come here and talk to you in detail and explain the object of the Association of Street Cleaning and Refuse Disposal Officials of the United States and Canada. This organization has been in contemplation for some time. Thanks to the efforts of Commissioner Fetherston and Secretary Buchanan, of the New York City street cleaning department, for their unceasing work and patience, it has now attained a growth which assures that branch of civic government an exchange of knowledge unsurpassed by any theoretical students of municipal problems. This is our main object; we hold that an interchange of ideas from practical men that have made our particular branch a study, not from theory and unfathomable figures, but from actual experience work, thus giving cities or hamlets the benefit of a vast field of knowledge that could not otherwise be obtained.

Street cleaning is not a romantic subject. It does not arouse the enthusiasm of citizens like new public buildings or similar work of construction. It is not so exciting as putting out a fire or suppressing a riot. It is less of a kid-glove job than caring for parks and playgrounds. Like woman's work, it is never done, but has to be repeated day after day and week after week.

The best street cleaning superintendent is the man you never hear about, because, if his work is done well, nobody ever thinks of him. If his work is neglected or badly done, he gets his name in letters an inch high on the front page of every paper. Yet, the street cleaning department is often the first agency of the city to feel the pruning knife, when it is necessary to cut down expenditures. That is how much glory there is in the street cleaning business. A street cleaner may save lives, by combatting unsanitary conditions, but he gets no hero medals and no monuments.

I am not complaining of my job. I am simply explaining in advance why certain facts of which I will treat have escaped general attention. For example, it is common to divide paving costs under two heads, the cost of construction and the cost of repair. I maintain that the cost of cleaning is fully as significant a factor as the cost of repairs and is entitled to equal consideration in deciding any question of paving policy.

The street cleaners' task is more directly reducible to a question of dollars and cents than is the paving engineers'. When a street is clean, it is clean and there are no degrees of super excellence to aim for. It must be the superintendent's continual study to effect this cleaning as cheaply as possible, both because the public grudges money for street cleaning and because, if there is sufficient money, what is saved in economical cleaning can be applied to more frequent cleaning. Therefore economy must be the theme of any practical discussion of street cleaning. I will try briefly to tell you the result of my experience in three elements of economy:

First, the cheapest method of cleaning pavements.

Second, methods of reducing litter.

Third, paving policy with a view to saving the cost of cleaning.

The use of flushers has proven not only the cheapest, but the most satisfactory method of street cleaning that our experience in Cleveland has been able to develop. We still make a considerable use of hand sweeping, but to make my point clear I need only refer to the statistics of our department, which show an average cost of 15.3 cents per square of 10,000 square feet for flushing, to which must be added practically 9 cents for pick-up work, a total of some 24 cents per square as against 42 cents for the work of the white wings.

The white wing is too convenient and necessary an adjunct to be wholly displaced under any conditions. Down town streets must be swept continuously during the day and the hand sweeper, with his small cart, can also work to advantage in the gutters of residence streets, collecting dirt that has either been flushed or blown to the curbs. But so far as our experience goes, the lessening of cleaning cost by cheaper methods means simply the extension of the use of flushers at every practical point.

There is an argument of sanitation in favor of the flushing method of cleaning. Dust breeds infection and is ex-

AUTOMATIC FLUSHERS AT WORK.

COMMISSIONER GUS H. HANNA DIRECTING HIS PICK-UP SQUAD.

tremely unpleasant where it is not dangerous. Hand sweeping causes a certain amount of dust and mechanical sweeping usually causes still more. However, with all that can be said on this score, I am opposed to simple sprinkling as a means of laying dust. Ammonia and other products leach out of damp manure and form a scum on the surface of the street that is nearly impossible to remove and makes the pavement slippery and foul smelling. Water should always be applied with force enough to carry the refuse to the gutter, where it should be promptly collected with brooms and shovels and removed.

The prevention of litter in streets has been carried farther, perhaps, in more congested cities than has yet been necessary in Cleveland. Even in our most crowded quarters, the street and sidewalks are rarely used as locations for garbage and ash cans, so one fruitful source of trouble in certain eastern cities is minimized in our case. We are reasonably successful in teaching the public to use waste paper boxes, but there is always room for improvement in such works of public education. We have tried during the past year to organize volunteer corps among school boys and girls who will use their influence against the useless littering of streets. The success of the venture is still at issue.

On the long run, nothing encourages carefulness on the part of the public so much as efficient and careful cleaning. A man does not hesitate to throw paper or rubbish in a street that is already foul. He thinks twice if the street is neat and clean. If there is a waste box at hand with a printed word of suggestion on the outside, he is apt to use the box.

The greatest source of expense in Cleveland has come, not from those who use the street for traffic, but those who use it as a place of business. A few hundred square feet near a certain street corner cost our department $10,000 to keep clean during the year last past. It is the location of a curb market, supposedly a farmers' market, but really the resort of professional hucksters who dispose of provisions that have often become shopworn in adjacent market houses before finding their way to the curb. It would be a small return for the privilege of doing business in the street to require these hucksters to keep their surroundings clean at their own expense on pain of arrest or forfeitures of their privileges. My annual report recommends that some method be found of ridding the city of this form of imposition, and I think that if the principle is applied in most cities to their market districts it will result in a considerable saving of cost.

In certain localities the mud that is tracked upon pavements is the greatest source of cleaning cost. Paving policies should be carried out with a view to having a minimum number of unpaved approaches to existing pavements. I want also to point out the need of protecting narrow rural pavements from the overflow or tracking of mud that originates on adjacent portions of the same highway. Where half of a road is paved, care should be exercised to prevent the unpaved portion from draining across the paved portion. If the pavement is so narrow that teams must turn partly off from it at meeting points, the berms should be covered with broken stone or cinders to prevent tracking mud on the pavement. Few streets are so dangerous to auto traffic as a narrow suburban pavement with a film of fluid mud over it. The pitch frequently encountered on such pavements is enough when covered with slime to keep an auto continually skidding toward the curb. The cost of cleaning, under these circumstances, is higher than on other streets with ten times the traffic. With proper drainage a shower ought to be a means of cleaning, not a means of contamination for an outlying pavement, even tho it covers only a portion of the roadway.

But the foregoing measures are not so important or effectual in saving the cost of street administration as is the construction and maintenance of pavements that are easy to clean. It is a continual wonder to me that so little weight is given to cleaning cost when paving questions are settled. An annual expense of $500 a mile in repairing residence streets would be considered an appreciable item of maintenance, yet that figure for cleaning a mile of residence street thru a season is extremely low. A cost of $500 for maintaining a mile of one kind of pavement for a year as against a cost of $1,500 for maintaining another kind would be sufficient grounds, in most cases, to decide in favor of the former material. Yet greater differences than this in cleaning cost as between competing types, are blandly overlooked.

A street cleaner looks for two qualities in a pavement. It must be smooth and particles of litter must not stick to the surface. The question of smoothness opens up the whole matter of durability. Any material that deteriorates and roughens becomes more difficult each year to clean. Any neglect of needed repairs means a larger cleaning bill until the repairs have been completed. I do not think it is necessary for me to discuss the durability of materials. Many of you are authorities on that subject. I merely wish to emphasize one thought that should enter into all your calculations of expense, and that is the two-fold expense resulting from wear, the cost of repairs plus the increased cost of cleaning.

CLEVELAND WHITE WING.

Additional calculation of cleaning expense must be made for all bituminous pavements on account of the sticking of particles of litter to the surface. These surfaces are never quite so clean as non-adhesive materials and it costs from 25 per cent. upward in additional cost to put them in a reasonably presentable condition, on account of this quality.

This difficulty is seen at its worst in a new creosoted wood block pavement, when the oil is gradually working out between the pores of the wood. The use of steel scrapers must often be employed, as the flushing by water is not effective at all in removing the dirt from such a surface.

The substances most easily cleaned, that enter into pavements, are brick and stone. Neither of them originates any form of dirt and both wash off readily. The only ground for discrimination between them is on the question of smoothness, where brick has a slight advantage as a rule. But in the use of these materials, the choice of a filler is all important. A bituminous filler has all the disadvantages of a bituminous surface, from a cleaner's standpoint, and some others besides. Being softer than the brick or block, it recedes, leaving a crevice that invites the lodgement of dirt. With the edges of the brick or block unprotected, it is sure to roughen, thus adding to the difficulties of cleaning. In fact, such a street, after a few years, presents an array of cobble stones, with the filler invisible or else melted and run to the gutter where it impedes the work of the follow-up gang.

So what I say in praise of brick and block pavements is mean to apply only to those built with a cement grout filler. I regret that I must rely upon general observations rather than exact data in supporting some of my statements, but it happens that we have in our office the result of observations made upon West Fourteenth street, in Cleveland, with a view to determining the cost of cleaning. This is a grouted brick thorofare that has been paved some ten years and yet is in good enough condition to serve as a model of minimum cleaning cost. This street has a traffic of about two vehicles a minute. It has been cleaned, on an average, five times a week, being flushed by night and hand swept in the day time. The sweeper worked almost exclusively in the gutters, as most of the dust on such a pavement will be blown to the curbing in dry weather. The cost, per cleaning, amounts almost exactly to 15 cents per 10,000 square feet, which we call a "square" and use as our unit of calculation.

This is the lowest figure that we have been able to achieve on any type of pavement. The cost on the best asphalt pavement would not be less than 20 cents and would rise to 30 as the surface became wavy or rough. A wood block pavement costs practically a dollar a square to clean in its initial condition, and it will be at least two years before the oil will have dried out sufficiently to admit of its being cleaned for 30 cents a square. A tar-filled block pavement will cost not less than 30 cents per square, and, as the filler disappears and the block roughen, this cost will amount to 60 cents or more.

WEST FOURTEENTH STREET, CLEVELAND, OHIO.

So you can see how much weight I would put upon the question of cleaning cost in the selection of a material as well as its construction. In the case of a pavement forty feet wide, there are about twenty-one squares to the mile. As between a material that can be cleaned for 15 cents and one that can be cleaned for 30 cents, there is a difference of $3.15 per mile per cleaning, a difference of $15.75 per week, of $630.00 per season of forty weeks and $6,300 in ten years. And instead of 30 cents the cost of cleaning the latter pavement mounts to 60 cents per square, as is not uncommon under conditions of wear, the excess of cleaning cost being $1,800 for a year or $18,000 for a decade above the figures that we have shown to be attainable on West Fourteenth street. The successes of our department and the good sanitary record of our city are attributable in no small measure to the fact that we have miles of this type of brick pavement.

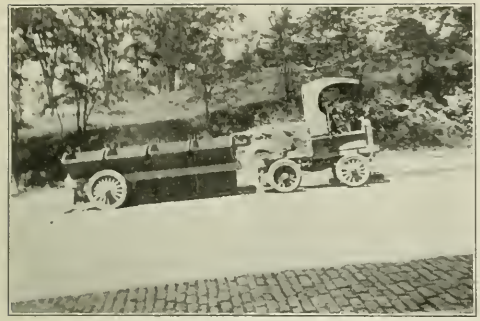
Cleaning costs can be greatly reduced by a policy of prompt repairs. I believe in the continual patrol of all city streets by men whose duty it is to discover defects in pavements and prescribe repairs. Even from the standpoint of repair cost, such a system saves money. When cleaning is considered, as well as repairs, the saving of a patrol system is so great as to make any other system a luxury.

The bad pavement is the despair of the street cleaner. Every town has streets that ought to be called graveyards. There lie the remains of past paving failures, rutted, rough and unsightly to reproach the men who laid them. As a street cleaning superintendent my last word of advice to you is to tear such pavements up and build pavements in which you can take pride. Build for ease of traction, build for durability, but also build for sanitation. Build a pavement that can be washed and kept clean. Such a policy is not expensive. The real extravagance is to keep pavements on your streets that are a barrier to traffic, a breeding place for germs and a burden upon the street cleaning department to keep in a condition of half-way respectability.

In view of our experience and the economy of cleaning streets of one kind compared with that of another, as well as the difference in economy that is apparent to the man on the job, of a street out of repair and one in a maximum state for use, I wish to seriously submit for your consideration as to whether or not those who design, construct and select pavements, have not lamentably failed in measuring the economy of a pavement by excluding every consideration which is involved in keeping them in clean, sanitary condition, confining their consideration simply to cost of construction, maintenance and repair.

Gasoline-Electric Tractors in New York Street Cleaning Service

For some time past the New York street cleaning department has been trying out various tractor and trailer combinations for the collection of ashes, garbage and street sweepings, as well as for mechanical sweeping and flushing of streets. The experience gained in this experimental work showed that while the electric tractor was highly desirable from the standpoint of operating simplicity, the mileage limitation imposed by the storage battery equipment was a handicap. Further, that because of the many stops in collection work (60 to 100 per hour), the gasoline tractor with gear



GAS-ELECTRIC TRACTOR *hauling garbage collection truck up steep grade on granite block pavement.*

transmission clutch, spark and throttle control was not only impractical but presented the disadvantages of greater complication with the resulting necessity for a higher class of drivers.

It has long been appreciated that the real work of street cleaning and flushing must be done at night, and the collection of refuse during the day. This calls for at least sixteen hours service in twenty-four.

A type of tractor which would be capable of practically continuous operation, and adaptable to either kind of service, was evidently necessary. A tractor equipped with a gasoline engine driving an electric generator, whose output could be used in motors driving the rear wheels was accordingly chosen as having the simplicity of control of an electric vehicle and the relatively large mileage capacity of straight gasoline equipment. This combination also presented the advantage of providing, in the most convenient form, energy for driving the auxiliary apparatus used in street sweeping and flushing.

Except for railway service, comparatively little development has been carried thru on vehicles driven in this way, and the problems involved in the design of the tractor were of a very complex nature.

A semi-technical description of twelve tractors which have been constructed by the General Vehicle Company, Inc., of Long Island City, for the department of street cleaning, city of New York, follows:

The tractor frame is built of structural shapes, amply reinforced and is carried on semi-elliptic springs of generous proportions. Wood bumpers, reinforced with steel, protect both front and rear ends.

The axles are both made of round alloy steel, and the wheels are carried on Timken roller bearings.

Two sets of brakes, both of the internal cam expanded band type, are provided, both for foot operation, one engaging drums on the rear wheels, and the other drums on the intermediate gear shafts.

The motors are suspended by links from extensions of the rear spring hangers, and by extensions of their cases which bear on the rear axle. The motors drive by spur gears to intermediate shafts, which carry pinions engaging with internal ring gears mounted on the rear wheels. The use of pressed fabric pinions on the motor shafts resulted in extremely quiet operation. The motors themselves are, except for the special cases, of the standard automobile type with ball bearings.

A consideration of the heaviest operating service, which will be when performing the work of street sweeping and flushing, showed that the power consumption over and above that necessary for propelling the tractor and sweeping and flushing trailer, would be about 15 h.p. Taking into consideration the probable mechanical and electrical losses, and the requirement for traction of approximately an equal amount, a 40-h.p. gasoline engine was thought to be a proper selection. The engine used in the tractors is a 4-cylinder Waukesha, cylinders cast in pairs with 4¾x6¾-inch cylinders. This is equipped for forced lubrication, has a zenith carburetor, dual ignition system with Bosch magneto, centrifugal water pump circulation thru a large Rome-Turney radiator built in an aluminum shell and supported directly on the frame without springs. A centrifugal governor maintains a rotative speed of 900 r.p.m., this latter being the rated speed of the electric generator.

The generator was built by the General Electric Co., and is rated at 15 k.w., 125 volts, 120 amperes at 900 r.p.m. The electric wiring is all carried in metal conduit, and controller, cut-out switch and ignition switch are placed in a sheet steel box beneath the driver's seat.

On account of it being necessary to operate close to the curb a great deal of the time, a right-hand drive was chosen, and the controller handle is also placed so as to be operated by the driver's right hand. In order to make it unnecessary for the driver to concern himself with anything other than the controller lever, brake pedals and steering wheel, a magnetic device for operating the carburetor throttle is provided to automatically open the throttle when the controller lever is moved in either direction from neutral. This is accomplished by the use of a solenoid of the plunger type which is connected by linkage to the throttle lever. The coil in the solenoid is connected in multiple across the generator terminals thru a contactor on the controller shaft, which is so arranged that a slight motion of the controller handle from neutral position in either direction will close the circuit, and automatically speed up the engine before the driving motors begin to draw current. A protecting resistance is automatically cut into the circuit by the plunger before it is entirely seated. The engine operates on fixed spark and the spark is automatically retarded when cranking by means of linkage actuated by the ratchet which the starting handle engages. The controllers are of unusually heavy construction for vehicle service and are arranged to give five speeds forward and two reverse. The driver's seat is protected by a cab.

A steering gear of the double screw and nut type with slightly raked steering post is provided, and provision has been made in the design of the front axle and steering knuckles for an unusually large turn of the wheels so as to

LIFTING WATER-TIGHT CANS *of refuse from garbage collection truck to discharge into scow. Gas-electric tractor at the left.*

give a small turning radius. The tractors were also built with the shortest possible wheelbase consistent with accommodating the trailers to be used with them in order to permit turning tractor and trailer in a narrow street. It was found possible to reduce the wheelbase to 72 inches and with the long refuse trailer in place it is possible to turn the tractor and trailer in a 30-foot street. Shadbolt fifth wheels are used on all the equipment so that any tractor can be quickly connected up with any of the trailers.

The total trailer load; that is, weight of trailer and material carried, is 20,000 pounds, for both collection and sweeping and flushing trailers. On test the tractors have shown a speed of about 8 miles an hour on the level and from 3 to 3½ miles per hour up a 6½ per cent. grade. These tests were made carrying load nearly 10 per cent. in excess of the rated load. In collection work each tractor and trailer will carry four men besides the driver who will supervise their work. In ordinary districts a crew of this size will be able to handle the work rapidly enough so that the tractor will be in operation more than it is standing. At the dumping dock the collected material, which is carried on the collection trailer in eight water-tight cans, will be lifted out and dumped by electric locomotive cranes, and it is expected that when these are in full operation the work will be handled very expeditiously.

The trailers to be used in the work of street sweeping and flushing will include a tank to carry 1,500 gallons of water, sprinkling and flushing nozzles and a rotary broom, also operated by electric motor. On the basis of tests which have been made on equipment performing these same functions, it is expected that great saving will be effected in this work also. When all the equipment is in service the department expects to be able to operate the tractors practically sixteen hours a day and it is needless to say that if this is done, a high standard of efficiency will be obtained.

Hypochlorite or Chlorine Sterilization for Water Supply of Milwaukee

The remarkable decrease in the typhoid death rate during the past two years has proven conclusively the wisdom of treating our water supply continuously under proper supervision.

The typhoid death rate of 11.54 per 100,000 of population for the year 1913, which was the lowest in thirty-nine years, was still further reduced to 8.25 per 100,000 of population during 1914. The hypochlorite plant was in continuous operation during the year and the average efficiency was 96.56 per cent. of all bacteria destroyed.

While no difficulties were encountered in applying this method of treatment during the summer months, taste and odor were very perceptible on a number of occasions when the temperature of the water was below 38 degrees F., in spite of the amount of bleach having been reduced to 0.1 part available chlorine per million parts of water, or 2.3 pounds of bleach per million gallons of water. With a reduction in the quantity of bleach applied, a high efficiency of the plant could not be maintained, and fermentation in 10 c.c. of treated water occurred on quite a few days. To increase the quantity sufficiently to avoid fermentation would immediately follow with taste and odor and scores of complaints from consumers. Many consumers could not be convinced of the harmlessness of the treatment, and while the increase in the bacterial count warranted an increase in the quantity of bleach applied, the department did not dare to do so in quantities sufficient to obtain satisfactory results. For these reasons the superintendent recommends the use of liquid chlorine in place of hypochlorite of lime. The use of liquid chlorine has been found very successful in plants where it is used for the treatment of water, and as it does not impart taste or odor and practically eliminates all labor costs, from a financial standpoint alone it is in the interest of the department to make the change.

Municipal Asphalt Repair Plant of Washington, D. C.

The municipal asphalt repair plant of Washington, D. C., is operated almost entirely on mixture of old materials, taken from streets being resurfaced, only about 4 per cent. of its product being new material during the year 1914-15.

The average daily output during the 240 days the plant was operated was 725 cubic feet, which corresponds fairly with the experience of past years. The quality of the output is entirely satisfactory and the economy of the use of old material is marked. The old material as removed from the streets is hauled to the asphalt plant, and during the past year the crusher has been so operated that the material was laregly crushed as received, instead of being allowed to accumulate before crushing operations were begun. This has resulted in a marked reduction in the cost of crushing, which was 74 cents per cubic yard, including all overhead charges, as compared with $1.04, the analogous figure for the preceding year.

The crushed material is placed in the heating drum, with an admixture of a formulated amount of sand, stone screenings, and limestone dust, and heated to a prescribed temperature and then transferred to a mixing drum. Therein it is mixed with a charge of fresh asphaltic cement and thence transferred to the carts and taken to the street. The proportions of the various ingredients are constantly under observation, and slight variations therein are made from time to time, as observation indicates their necessity. This detail is a most important one, due to the fact that the old material, as received from the street, is not a constant product, while the resultant mixture to be replaced on the street should be approximately such.

Sand cost $1.07 a cubic yard; asphalt cement, $15.50 a ton; limestone dust, $2.20 a ton; screenings, $1.53 a cubic yard. Fuel oil cost 7 and 3.45 cents a gallon; coal $3.68 a ton, and wood $5 a cord.

In operating the crusher ninety-nine days with 4,790 cubic yards output, labor and fuel cost 57.1 cents a cubic yard; maintenance, renewals and repairs, 7.8 cents; overhead charges, 9.3 cents, including interest on capital invested at 1½ per cent. and obsolenscence, five years life of plant, at 20 per cent., making the total cost of the crusher 74.2 cents per cubic yard of the product.

The asphalt plant cost was 5 cents per cubic foot; haul from plant to street, 4 cents; street labor, 11.6 cents; maintenance and repairs at plant and on street, 0.74 cents; sharpening tools, 0.5 cents; overhead charges, interest and depreciation, 0.9 cents; foreman and overseers, 3.5 cents; making the total cost 26.24 cents a cubic foot. New materials added cost as follows in averages per cubic foot of the mixture: 0.23 cubic feet sand, 0.92 cents; 0.06 cubic feet screenings, 0.34 cents; 2.1 pounds limestone dust, 0.25 cent; 3.66 pounds asphaltic cement, 2.82 cents, making the total material cost 6.13 cents per cubic foot. Adding the manufacturing and placing cost from above, 26.24 cents, makes the cost of the mixture 32.37 cents a cubic foot as laid in the street using old material.

Using the manufacturing and placing cost above, 26.24 cents, the cost of new asphalt top is computed at 40 cents a cubic foot in the municipal plant as compared with 47 cents, the price by contract for class b mixture. For class a the costs are 47.23 and 52 cents, respectively; for binder class b 34.6 and 39 cents, and for class a 37.6 and 41 cents, respectively.

The cost of asphalt repairs for the year distributed over the yardage of asphalt pavements not under contractors' guaranty averages 1.8 cents per square yard.

ROADS AND PAVEMENTS

Gravel Roads Notes

West Virginia has had such good success in working both state and county prisoners on the repair and reconstruction of roads during the past three years that they are now being used in the construction of reinforced concrete bridges for under and over grade crossings of highways and railroads.

It is proposed to Congress to pass a law prohibiting states from collecting an additional automobile registration fee from automobilists who have already paid fees and complied with the regulations governing automobiles and automobilists in their home states, thus making automobile traffic over state lines as free as other traffic is at present. This will eliminate some disagreeable features of interstate travel, especially in such cases as New Jersey, where there is a very plausible argument in favor of charging fees for foreign automobiles because of the large number of automobiles from the great cities on and near its borders which make full use of New Jersey roads, and under the proposed law would not be required to make a contribution to the upkeep of such roads.

The National Highways Association is publishing a series of maps of the principal transcontinental lines of highway proposed or located and under construction. The latest map is one of the Midland Trail, with branches from Washington and Richmond, Va., meeting in Charlottesville and running west thru Charleston, W. Va., Frankfort and Louisville, Ky., Vincennes, Ind., St. Louis and Kansas City, Mo., along the Union Pacific railroad to Denver, Colo., thence by several routes to Grand Junction, Colo., thence west thru Salt Lake City, and thence southwest thru Copper Falls and Tonopah, Nev., to Los Angeles, or to San Francisco. Its route thru Missouri is that of the National Old Trails road and thru part of Utah and Nevada is that of the Lincoln Highway.

The southern section of Market street, the principal mercantile thorofare of Chattanooga, Tenn., has just been paved with wooden blocks, which displace the old cobble stones. The Southern Paving and Construction Co., of Chattanooga, places the layer of concrete necessary to bring the old cobble stone pavement to even grade, and lays the pavement. This is the first wood block street in the city of any extent and costs $50,000.

On November 26, the board of county commissioners of Cook county, Ill., were the guests of the Associated Roads Organizations of Chicago and Cook County on the first annual inspection of state-aid roads laid in Cook county, Ill. The trip covered 110 miles of good and bad roads entirely within the limits of Cook sounty, except one short excursion into DuPage county to see the concrete pavement laid by the DuPage county board on Wheaton road, an extension of the Twelfth street concrete road of Cook county. In several towns along the way the citizens extended enthusiastic receptions to the county board and the good roads sentiment in Cook county sustained a remarkable impetus.

The trip was so arranged as to cover typical improved highways as well as some of the unimproved roads. The rainy weather which prevailed served to call forcibly to the attention of the commissioners the contrast between muddy, unimproved highways and the concrete roads built by state-aid.

Under the law as originally framed, the county was not permitted to build roads within village limits. The error of this was excellently shown on the Twelfth street road, where alternate good and bad stretches were encountered. The good stretches were those built under state-aid and the bad spots were unimproved stretches on the same road within village limits. There was a sigh of relief each time a good road was raeched. By an amendment to the Tice law of Illinois, the county is now empowered to pave the bad stretches thru villages with a population of 20,000 or less.

The seven-mile stretch of concrete road on Milwaukee avenue, one of the principal thorofares leading to Chicago and used largely by automobilists and truck farmers, was included in the trip. This is the longest continuous stretch of concrete highway in Illinois.

Road Contracts Awarded by State of Ohio in Year 1914

Type of Road	Miles	Total Cost	Average Cost Per Mile
Brick	156.49	$3,283,497.84	$20,982.04
Concrete	120.54	1,714,956.51	14,227.28
W. B. Macadam	181.46	1,565,593.66	8,627.76
Gravel Macadam	4.38	36,639.50	8,365.18
Bit. Macadam	16.68	184,563.70	11,064.97
Bituminous Surface, Treated Macadam	7.46	56,244.50	7,509.28
Glutrin Surface Treated Macadam	2.00	15,430.00	7,715.00
Grading	6.05	20,392.24	3,370.62
Total	495.09	$6,877,299.95	
5 Contracts for Bridge Structures		33,233.83	
Total Cost		$6,910,583.78	

Monolithic Brick Pavements Successful in Illinois

Rodney L. Bell, engineer in the Illinois state highway department, states that the saving in cost of construction of monolithic brick paving over former methods is 10 to 15 cents a square yard. His principal reason for favoring the new method, however, is the entire absence of sand between the brick and consequent thoro grouting of joints and formation of a monolithic surface. He told the Northwestern Road Congress at Grand Rapids, Mich., that tentative experiments in

TEMPLATE *by which dry mortar mix is spread on green concrete base just in advance of brick laying.*

the abolition of the sand cushion had been made in Baltimore, Cleveland, the Pennsylvania new terminal in New York, Springfield, Mo., and elsewhere, so that the idea is not so new, altho the completeness of its working out in Illinois is an advance upon any previous construction.

Cross expansion joints are not favored by the Illinois highway department, as they think such joints are destructive of brick road surfaces.

A brick pavement in Chrisman, Ill., laid in 1914, which blew up, showed that the sand had been forced up by the rolling of the brick at least half the 4-inch depth of the brick and had prevented the thoro filling of the joint with grout. The stress due to the expansion of the surface by the heat of the sun was thus concentrated so that the blowing up was the only thing the pavement could do.

In Illinois brick road construction the rough work on the sub-grade is done with traction engine and grader, the engine thoroly compacting the sub-grade The grade being dressed by hand, is further compacted by the 5-ton, self-propelled roller, which hauls the materials. Steel forms are set true to line and grade, 8 inches in depth and 12 feet long. The concrete base is 4 inches thick and the brick are 4 inches in depth, making, when completed, an 8-inch monolithic pavement. Steel forms, while not absolutely essential, are a great convenience in this type of construction, according to Mr. Bell.

The concrete for the base is 1:6 mixture of cement and washed gravel. The gravel tests very close to 50 per cent. thru a ¼-inch square mesh. The base for the state-aid work now under contract will be one part cement, three and one-half parts fine aggregate and six parts coarse aggregate. Enough water is used so that the concrete is of a quaky consistency, but will not flow. It is found that an excess of water causes trouble in keeping the brick up to a true surface.

In order to get approximately the right thickness of concrete before cutting it with the template, a small wooden guide is used. The steel template used is necessary in order to secure accurate results on this type of work. This template, shown in one of the accompanying photographs, is made up of a 6-inch I-beam in front and a 6-inch channel behind. They are placed 2 feet apart and supported by four rollers, one at each end of each member. The rear edge of the template is set exactly 4 inches below the top of the forms and the front edge is set 4 3/16 inches below the top of the form. The hopper-like space between the two edges is kept filled with a dry mix consisting of one part cement to five parts sand. The

COMPLETED PAVEMENT *in foreground and the next day's work just beyond, ready to receive the joint grouting.*

template is drawn forward, the front edge cuts the concrete 3/16 inch below grade and a thin film of dry mortar is spread over the concrete, filling all the little depressions in the surface. Theoretically, the dry mortar coat should be exactly 3/16 inch in thickness. In reality, it does not have any noticeable thickness, but is sufficient to give a perfectly smooth surface for the brick.

It is essential to have the brick rolled carefully and thoroly and the grout applied in the most approved manner, so as to fill the joints completely and combine bricks horizontally into a monolithic mass in order that the combination with the foundation thru the mortar cushion may retain its monolithic character also.

The accompanying photographs show the double template smoothing off the concrete and the dry mortar cushion on top of it; the edge of the pavement and the thoro bonding of foundation and bricks together, and the surface of the finished pavement.

GROUT FILLER *is shown extending to bottom of brick, thus bonding foundation and brick surface into a solid monolith.*

MISCELLANEOUS

This New City Wants Everything

It has been a good many years, even in the fast-growing Southwest, since a town of nearly 2,000 population has been confronted at one time with practically every problem of engineering that is necessary in the building of a city. Ringling, Okla., is an oil-field town, but it is more than that. It was incorporated early in November. J. L. Hamon, vice president and general manager of the Oklahoma, New Mexico & Pacific Railway Company, who laid out the townsite, had it platted and offered its lots for sale, of course dictated where business houses should be erected, and he had the streets graded. The town grew to a population of 1,000 in a few months, without any form of municipal government.

Late in November the first town officials were elected. Frank L. Ketch, claim agent for the Oklahoma, New Mexico & Pacific Railway Company, who has had charge of the sale of town lots, was elected president of the board of trustees, which makes him, in effect, mayor of the town. Mr. Ketch has had experience in municipal government, having been a member of the city council in Lawton, Okla., for several years, and he organized the board and set it to work in a business-like manner.

It now becomes the duty of the board to provide the necessary public utilities, and it is a serious one, for Ringling is likely to have several thousand population long after the cream has been taken from the oil business.

Ringling is far out on the prairies of a long-used cattle country, 30 miles from Ardmore, 30 miles from Waurikax, and 40 miles from Lindsay, which gives it a trade territory of approximately 300 square miles in which are developing agriculture, livestock raising and asphaltum mining, as well as oil and gas and other minerals. In the rain belt of Oklahoma and in a region where 90 per cent. of the land may be cultivated, there was not left in the state so large a section of country untouched by a railroad or in which a modern town had not been built.

J. L. Hamon is organizing a gas and electric company. Gas from one of his wells, which has a daily capacity of 52,000,000 cubic feet, is already in town.

A water works system will be a necessity at once. Quite a number of permanent buildings have been constructed, but many lot owners are awaiting the installation of a water system before expending much money in building. The town officials also plan to put in a sewer system as soon as revenues will permit it. Asphaltum mines are located only a few miles northwest of the town, and street paving is likely to be considered within a year.

Calendar of Meetings of Associations

The Indiana Engineering Society and the Indiana Water Supply Association will hold their annual conventions together at the Claypool Hotel, Indianapolis, on February 2, 3, 4 and 5, 1916. On February 4 the two associations will hold joint sessions and a joint banquet. The exhibit feature of the joint conventions will be of more than usual interest. Charles Brossmann, 1616 Merchants Bank building, Indianapolis, is secretary of the Indiana Engineering Society, and Dr. W. S. King, State Board of Health, of the Water Supply Association.

The American Wood Preservers' Association will meet at Hotel Sherman, Chicago, Ill., January 18, 19 and 20, 1916. The sessions are open to those interested. The effects of the war on the supply and use of preservatives will be shown. Special committees of experts will make elaborate reports on preservations, specifications for timber, wood block paving, etc.

The Illinois section of the American Water Works Association will meet at the University of Illinois, Champaign-Urbana, January 25 to 27. Edward Bartow, secretary, Urbana, Ill.

The Illinois Society of Engineers and Surveyors will meet at the University of Illinois, Champaign-Urbana, January 26-28. Joint sessions with the Illinois section of the American Water Works Association will be held January 26 and 27.

The next convention of the American Road Builders' Association will be held in Pittsburg, Pa., February 28 to March 3, 1916. The usual Good Roads show will be held in Mechanical Hall, Du Quesne Way. The American Highway Association has been invited to hold its convention at the same time and place without expense to it and to arrange programs which will co-operate, also to continue the plan, the two associations to alternate in control of the conventions and shows. E. L. Powers, secretary, 150 Nassau street, New York.

The second national conference on concrete road building will be held in Chicago in connection with the cement show, February 15 to 18, 1916. The work of the conference is in the charge of seventeen sub-committees with definitely assigned groups of subjects. J. P. Beck, Chicago, Ill., is secretary.

The American Concrete Institute will meet in Chicago in connection with the cement show February 16-18. John M. Goodell, secretary, Philadelphia, Pa.

The American Concrete Pipe Association will meet in Chicago during the cement show February 17 and 18.

The South Atlantic Road Congress meets January 17 to 20 to prepare for a road building campaign in its territory.

Personal Notes

John A. Giles has been promoted from city engineer to commissioner of public works at Binghamton, N. Y. He has been city engineer since 1908.

Irwin S. Osborn, designer and constructor of the garbage

reduction plants at Columbus, O., and Toronto, Ont., has opened an office in the Rose building, Cleveland, O., with U. D. Allen, formerly building commissioner of Cleveland, for practice as consulting engineers.

Joseph A. Rourke, formerly assistant engineer of public works, has been put in charge of the high pressure water service, of Boston, Mass.

J. Herbert Shedd, one of the earliest civil engineers in practice in the United States, opening an office in his own name in 1859 after three years previous experience, has died in Woonsocket, R. I., at the age of 81. He has been connected with engineering work in Providence, R. I., as water works engineer, city engineer, harbor commissioner and consulting engineer ever since the year 1866.

James Mapes Dodge, chairman of the board of the Link-Belt Company, died on October 4. He was among the first to join in the development of the chain business with W. D. Ewart, the inventor of link belting, and has been identified with it ever since, the technical development of the company being his special idea. This idea as carried beyond the highly specialized expert study of the materials and methods used in improving the product of the factories into the design of plants for handling both raw and finished products of factories of all kinds, thus vastly improving methods and instituting great economies at the same time that business was developed for the belt manufacturing company. One of the most important of the problems solved was that of handling coal, the cost of which he reduced from 30 or 40 cents a ton per ton round-trip in and out of storage to less than 5 cents.

Henry Welles Durham, formerly chief division engineer of highways of the Boro of Manhattan, New York, and now a consulting engineer in that city, has been appointed county engineer of Bergen County, New Jersey. His work in this same line has included also sewer reconstruction on the New York subway work, resident engineer in charge of municipal engineering work on the Pacific slope of the Panama Canal Zone, particularly for Panama City. He will reside in Bergen County, but will retain his office for consulting practice at 366 Fifth avenue, New York.

O. S. Beyer, Jr., of Horton, Kan., has been appointed first assistant in the engineering experiment station in the department of railway engineering of the University of Illinois and his investigations will be conducted mainly in the locomotive laboratory, which has recently received a locomotive from the Illinois Central Railway, taken from regular service, repaired and presented to the university.

C. C. Blair, of the Bessemer Limestone Co., Youngstown, O., is this year's president of the National Paving Brick Manufacturers' Association.

George S. Iredell, formerly city engineer of Austin, Tex., has opened an office in the Littlefield building, in the same city, for practice as a civil and electrical engineer. He is now making bridge plans for the city.

G. M. Crawford has recently assumed charge of the drag line department of the Pawling & Harnischfeger Co., Milwaukee, Wis. Mr. Crawford, in years past, has been responsible for the development of many practical features of drag line excavators and may be said to be responsible for the application of electrical power in this field.

New Publications

"The Cost of Pumping Water" is the title of a collection of graphical charts with accompanying explanatory text issued by the DeLaval Steam Turbine Co., of Trenton, N. J. The object of the publication is to facilitate computation of the overall economy of different types of steam pumping units, having given the cost of fuel, steam pressure, rate of interest, cost of apparatus and other variables. The first chart shows the number of B.t.u. represented by each pound of steam for various combinations of superheat, steam pressure and feed water temperature. The second chart gives the cost of 1,000 pounds of steam and the cost of a million B.t.u.'s in the steam from the cost of coal per ton, the heat value of the coal and the boiler efficiency. The third diagram shows the relation existing between the average cost of steam-turbine-driven centrifugal pumping units and the head pumped against. The fourth diagram shows the amount of money to be set aside yearly for sinking fund, to cover depreciation for different terms of life and rates of interest. The fifth diagram is the well-known Mollier steam chart, supplemented by a convenient scale by means of which B.t.u. available per pound between given limits, the resulting velocity of steam in feet per second and the corresponding duty in foot pounds per 1,000 pounds of steam, and the pounds of steam per h. p.-hour may be read off directly. The sixth diagram is an alinement chart for determining the resistance of pipes to flow of water. Three scales represent gallons per minute, diameter of pipe in inches, and loss of head in feet per 1,000 ft. of pipe. A straight edge laid across points corresponding to known figures on two of the scales shows the third variable by intersection with the remaining scale. At the end of the publication is a list of representative municipal installations of DeLaval steam-turbine-driven centrifugal pumps, from which it is to be observed that units of this type have been installed for capacities as large as 100,000,000 gallons per day and heads as great as 334 ft., and have developed duties exceeding 150,000,000 ft. lbs. per 1,000 lbs. of steam. It is also pointed out that because of the low first cost of apparatus, foundations and buildings inherent in this type of pump, the total cost of pumping water is greatly reduced as compared with the much larger, heavier and more expensive triple-expansion reciprocating pumping engines, in spite of the somewhat higher duty exhibited by the latter. Copies of the publication are offered gratis to those interested.

There has just been published for the Watuppa Ponds and Quequechan River Commission, of Fall River, Mass., the report of the consulting engineers, Fay, Spofford & Thorndike, of Boston. Including the commission's report, this forms a volume of more than 200 pages, with copious illustrations from both photographs and drawings, as well as a pocket of maps showing different phases of the proposed development. Some of the engineering features are unique, including the three-story conduit for carrying hot discharge and cool condensing water for the mills, besides surface drainage. A common cooling pond is designed for all the mills along the river. The civic problems met include a new sewerage system, the abatement of nuisances along the river, the conservation and control of water, and a number of other items having unusual features. It is estimated that the proposed work will cost nearly three million dollars, of which almost one-third will be paid for from the sale of 146 acres of land to be reclaimed along both banks of the river.

Publications Received

Annual Report of the Engineering Department of Salt Lake City, for 1914, Sylvester Q. Cannon, city engineer, Richard P. Morris, commissioner of streets and public improvements. A report of the largest year's work yet done in the city, amounting to $1,435,835 of work actually done during the year and $921,726 of contracts partly completed.

Proceedings of the third annual meeting of the Montana Institute of Municipal Engineers, C. C. Widener, secretary, Bozeman, Mont.

"Some Problems of Street Paving in Large Cities" is the subject of a paper before the Municipal Engineers of the City of New York by Henry Welles Durham, consulting engineer, New York, and reproduced in a separate pamphlet.

MACHINERY AND SUPPLIES

Use of Portable Air Compressors

The city of Minneapolis, Minn., in enlarging the capacity of its water works system by the addition of 7½ miles of trunk pipe lines, made extensive use of a portable gasoline-driven air-compressor for furnishing air power on the work.

This compressor, as illustrated, has a capacity of 105 cubic feet of air per minute at 100 pounds pressure. The air is distributed along the trench thru 1,000 feet of 2-inch pipe, having outlets spaced at suitable intervals for hose connections. Armored air hose is run from the main to the air tools. Boyer air hammers are used for riveting and calking the pipe. The lower rivets are driven on the inside and the upper rivets on the outside. The reaming is done by a Little Giant air drill. Three riveting hammers, one calking hammer and one air motor are used simultaneously on the work. Sections of the distribution pipe and the compressor are moved ahead at intervals, and the work progresses without interruption.

The pipe is of the Lock Bar type, and is made up in sections 30 feet in length. This kind of pipe was adopted for economy in thickness of metal and carrying capacity. The pipe for the 48-inch distribution lines is 5/16 inch thick. The pipe for the 54-inch force main is 5/16 and ⅜ inch thick, depending on the working head on the pipe in the upper and lower portions.

The pipe is made up in truncated sections and assembled in the trench by telescoping. The joint is made up by a single row of rivets and the plates calked inside and outside. The rivet holes are centered by drifting and boltitng when the pipe is laid, and trued up by reaming. The rivets are driven and joints calked by the use of compressed air.

CHICAGO'S PNEUMATIC *Portable Gasoline Driven Compressor used in construction of filtration plant by city of Minneapolis, Minn.*

Free Distribution of "Roads" Book

The illustrated booklet, entitled "Roads: Their Influence Upon Economic and Social Conditions," is being distributed in large quantities by township, county and state highway engineers and superintendents.

This book, which is furnished for free distribution by The Garford Motor Truck Co., Lima, O., and is written by Mr. S. M. Williams, sales manager of this concern, is liberally illustrated, and, unlike the great majority of books published by industrial concerns, contains no advertising matter. Hundreds

of thousands of copies of this book will be distributed during the winter months. Officials who desire copies should address the publishers, giving number of copies wanted. The Garford Company will, on request, mail these booklets direct to names on furnished lists.

M. Griffin O'Neil & Sons, hydraulic and sanitary engineers, Dallas, Tex., in writing Mr. Williams relative to this "Roads" book, state:

"We are in receipt of your letter of August 21, addressed to our Mr. M. Griffin O'Neil, enclosing literature relative to your illustrated article upon 'Roads; Their Influence Upon Economic and Social Conditions.' You are to be congratulated upon this article. It should do much to stimulate the sentiment for good roads.

"For the past fifteen years our attention has been devoted largely to the design and construction of municipal improvements. We are beginning to turn our attention more than ever to good roads and street paving.

"To work up the sentiment for good roads to the point where the citizens will demand them, we have decided to use such literature as your illustrated article on roads, supplemented by picture films showing the advantages of good roads, and the disadvantages of the bad road.

"It is our intention, after having the films made, to take them to the counties that need roads and can afford to build them, and there show them in the towns and thruout the county in such meeting places as we can get the people to attend, such as the country school houses. Of course, we will have talks and discussions of roads in conjunction with the showing of the films and also put literature in the hands of the people that will tend to create a sentiment for good roads.

"We would like to have permission to reproduce some of the views and statements in your article, and would appreciate any suggestions or information as to the films and literature referred to."

Mr. J. L. Kelly, president Good Roads Association, The Dalles, Oregon, writes:

"Wasco county, Oregon, is a large county, 65 miles across, and it claims 1,100 miles of roads. The products of the county are largely fruit and grain, and many farmers are quite a long distance from market, and the county is hilly.

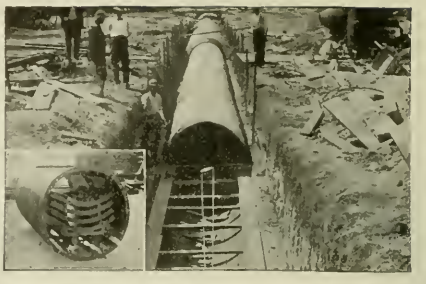
"There is a movement on at this time to bond the county for $262,500 for the purpose of improving the roads. If this bond issue carries and the roads are improved, it will also probably result in combination school districts so as to enable the country districts to have graded schools, the pupils to be carried to and from the school in school wagons.

"Your pamphlet mentioned above is a very creditable one, and applies in a peculiar way to conditions in this county. I think that two thousand of these pamphlets might be used to good advantage in this county at this time. It would enable us to educate the people up to the voting of the bonds and the improvement of the roads. If you can send me the number of pamphlets mentioned, I will see that they reach the voters of this county. If you cannot send that amount, I will make use of any number you can supply.

"Our campaign for the bond issue is now on and if these pamphlets and cuts are to be used, I should receive them at the earliest possible date in order to get the same in the hands of the people."

Steel Telescopic Sewer Forms

The illustrations show a new type of telescopic sewer form, with several distinctive features, which has been used on the Catskill aqueduct, comprising over 70 miles of tunnels; Astoria tunnel, Sandpatch tunnel, Louisville and Nashville railroad tunnels in Tennessee and Kentucky, and the New York and Boston subways.



BLAW *half-round sewer forms being shifted. Insert —Blaw telescopic full-round sewer form.*

BLAW *tunnel form on 76-inch full round tunnel: James Hanreddy, Chicago, Ill., Contractor.*

On a San Antonio, Tex., contract, 175 feet of these forms were collapsed, moved forward and reset in seven hours, this while concreting was going on on the balance of the forms used on this contract. This type of form is being used on four contracts in San Antonio.

The form is made in quadrants, the invert, or bottom sections being built with angles which form a track on which the small steel and wood carriage runs. After the forms have been erected, they are collapsed by removing bolts at the base thru the angles, and the wedge-shaped wood filler piece in the lower right-hand side of the structure. The wood filler piece is withdrawn and the four segments are placed one on top of another on the small carriage which runs on the invert of the forms. The carriage is then pushed thru the forms which are in posititon, and which are being concreted. A turnbuckle is used to line up the forms when they are being concreted. The manufacturers are the Blaw Steel Construction Co., Pittsburg, Pa.

New Ford Meter Testing Machine

The new model Ford meter testing machine, known as the Baby Ford, was primarily designed for the requirements of the smaller water companies and departments. This model is provided with a 1-inch Mueller inverted key stop valve at inlet end and outlet side is equipped with the Ford calibrated strip, by means of which any size flow, from 1/32 to 1 inch in ten steps may be passed.

The Fairbanks Company manufacture a special scale, having in addition to the regular beam a special water meter beam by means of which the error of the meter under test

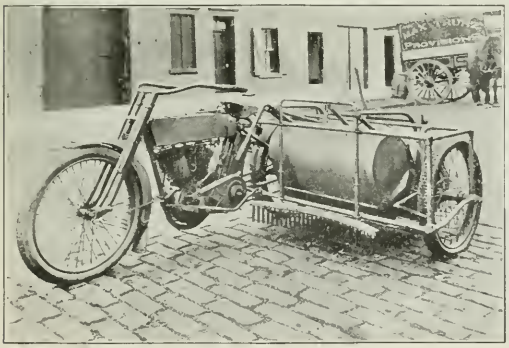
may be read directly in per cent., plus or minus. With the model testing machine now used, it is recommended that a tank of following dimensions be used: 12 cubic feet capacity, 22 by 56 inches, made of No. 10 and No. 12 boiler iron, and having a 1½-inch quick-opening throttle valve as outlet.

The Ford Type 4 testing plant is so arranged that one 1-inch and three ⅝ or ¾-inch meters may be tested simultaneously and with the same water, or any may be tested separately. This plant consists of a cast iron table 16 inches by 5 feet 4 inches supported by two heavy cast iron pedestals. Securely bolted to this table are four meter yokes, the first yoke being fitted to take any 1-inch standard water meter, the next three any ⅝-inch or any ¾-inch standard water meter. The inlet port is controlled by a 1-inch Mueller inverted core valve, as is also the 1-inch by-pass extending up from the outlet end of the 1-inch yoke and over the other yokes to the discharge point of the plant. The regular ¾-inch outlet valve is of the same make and pattern and is above the outlet end of the fourth yoke. At the outlet end of the last yoke is installed a vertical bronze plate 1¼-inches wide. This plate has seven different sized and accurately calibrated holes thru it from 1/32 inch to ¾ inch in diameter. By a very simple device this strip can be placed at any pre-determined place so that the flow of water will be compelled to pass thru the desired hole in the plate. By a partial turn of two hand wheels any desired change can be obtained. This plant is equipped with two 200-pound gages, four brass tubes or idlers to use in their respective yokes when that particular unit is not in use, connections and appliances necessary to take any standard ⅝, ¾ or 1-inch meter. The connections used in these yokes are adaptations of the standard Ford connections.

Motorcycle Street Sweeper

We are illustrating a motorcycle street sweeper as designed by the Harley-Davidson Mfg. Co., Milwaukee, at the left side of which is attached the refuse pick-up apparatus which carries a rotary broom 30 inches long and 16 inches in diameter. Just forward of the broom is placed a swinging dust pan for collecting the dust as it is swept up. The pan may be dumped by means of a hand lever while the machine is in operation. Mud clots and other hardened refuse adhering to the pavement are removed by a metal-toothed rake mounted in front of the pan.

The steel brush in front is held firmly to the pavement by two springs which have sufficient movement to permit of the brush being used in loosening street refuse even where granite, sandstone or other block pavement is used and the surface is uneven. The refuse is lifted into a receptacle by a rotary brush with practically no dust being raised, the brush being almost entirely enclosed.



The driving of the rotary brush is thru a gear connected with the motorcycle transmission from the motor thru the rear wheel. The raising and lowering of the brush is controlled easily by the operator with a lever convenient to his left hand.

Hose Connection for Power Street Flusher

A hose connection on a power street flusher is a very convenient adjunct, as is shown by the accompanying photograph of a Studebaker street flusher in use in Boone, Iowa, for spraying trees. A machine with this attachment can be used as

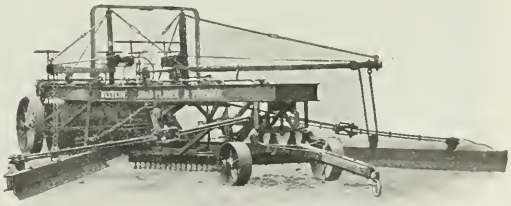
well for sprinkling lawns and grass in parks and outlying districts where the water supply is not within reach and for street sprinkling, throwing a spray which covers a wide road at one passing. The hose can also be used on emergency for extinguishing a fire in a building, in grass or in forest.

Combined Road Scarifier, Planer and Roller

The application of gasoline, oil and steam tractors for road building purposes has had the effect of revolutionizing the machinery employed for road building and maintenance work.

For several years municipalities, cities, counties and townships and also road contractors, have been purchasing high power traction engines and motor trucks capable of handling road-making machines of much greater capacity than had before been built.

To meet the demand for a heavy road machine for construction work, in conjunction with high-powered tractors, the Western Wheeled Scraper Co., Aurora, Ill., are marketing a new machine known as the Western road planer and finisher, a machine which combines the properties of a road scarifier, a planer and a roller.



WESTERN ROAD PLANER AND FINISHER.

The toggle principle is employed for opening and closing the blades and also for holding them at their various working angles. The front center and rear of each blade can be raised or depressed independently. The extreme width of cut that can be made is 30 feet, but it can be decreased to 15 feet by the turning of two hand wheels. The blades when folded for transportation rest on supports located above the front wheels of the machine so that there is nothing to prevent short turning. The weight of the rear end of the machine can be transferred to the face of the rolls as the machine passes along, thus increasing the roller pressure at will. The machine requires between 25 and 40-horse power to operate.

Tractors in Municipal Haulage

The city of Cincinnati, Ohio, recently decided to look into the merits of the gasoline tractor for municipal hauling. Among other things, it determined to find out how much tractors could haul, whether several trailers could be handled conveniently, whether the tractor engine was equal to the task of hauling heavy tonnage up an 8 per cent. grade and whether the tractor brakes could be depended upon to hold back the combined weight of several heavily loaded trailers down an 8 per cent. grade.

When preparations for the experiment were completed, a rugged-looking Knox tractor was brought on the scene. The place chosen for the test was Gilbert Hill, a 7,000-foot stretch, with a mean grade of 6.2 per cent.; maximum grade, 8.3 per cent.; minimum, 1.8 per cent. The surface of the street was granite block.

Six trailers were used, ordinary municipal type dumping wagons, as shown in the illustrations. The city authorities had specified that there should be no load whatever on the rear wheels of the tractor and the demonstration was accordingly made with the entire load rolling on steel wheels. The six trailers were loaded with mud and the total weight of this pay load, as shown by the city scales, was 38,500 pounds, making it an interesting matter for speculation as to whether the big "gasoline horse" would be able to haul this unusual load, weighing approximately twenty tons, to the summit of the hill.

The train was started at the bottom of the hill, made the ascent, turned at the top of the hill without stopping and with all the wagons tracking perfectly, and returned to the foot of the hill. In coming down the grade, the entire load was held back by the tractor only, the brakes on the trailers not being set at any time.

The tractor was brought down the entire length of this 7,000-foot grade in low gear. Two complete stops were made at the steepest part of the hill to demonstrate the ability of the tractor to hold back the load.

The weights of the trailers used in the demonstration, as shown by the city scales, were as follows:

Where five wagons were used:	
First two wagons	11,600 pounds
Second two wagons	18,000 pounds
Fifth wagon	8,950 pounds
Total	38,550 pounds
Where six wagons were used:	
First two wagons	11,600 pounds
Second two wagons	18,000 pounds
Third two wagons	16,070 pounds
Total	45,670 pounds

The weights in this demonstration were 25 per cent. in excess of the loads to be hauled by the city of Cincinnati in

VIEWS SHOWING KNOX TRACTOR. (1) *Making complete turn with five loaded trailers;* (2) *making 6½ per cent. grade with 38,550-pound load;* (3) *descending 7.8 per cent. grade at 3 miles per hour, tractor brakes holding back entire 38,550-pound load.*

actual service, and Knox equipment has, therefore, been purchased.

Another interesting instance of the successful working out of the tractor and trailer method is the hauling done by a Knox tractor owned by the city of Springfield, Mass. The illustrations show hot asphalt being hauled from Springfield to Indian Orchard—a distance of seven miles. As in case of Cincinnati, the trailer was of the regulation municipal bottom-dumping type. The first trailer carried 8 tons and each of the other two contained 2½ tons, making a total pay load of 13 tons. No difficulty was experienced in negotiating Armory street hill—a 6 per cent. grade—and the average running time between loading point and destination was said by the driver to be one hour.

The illustrations show one obvious advantage of the tractor and trailer for this type of road construction work—the ease with which the load may be dumped and spread in any desired position. Other advantages claimed for the tractor and trailer method are that the bulk of the paying load rolls on steel-shod wheels, that the power-plant may be transferred from one type of work to another merely by interchanging trailers, and that the trailer methed makes possible the highway transportation of such materials as steel girders, long lumber timbers and other commodities which cannot be hauled successfully by gasoline power in any other way.

Two-Wheel Eagle Trailers

We are illustrating a motor truck pulling two-wheel trailers whose actual draw bar pull shows exceedingly light draft. Eight of these 3-yard trailers, which are made by the Eagle Wagon Works, Auburn, N. Y., follow one another or track when turning at almost right angles.

These carts have steel axles with straight roller bearings, on wheel hubs, solid and strong everywhere. The chain device for raising doors has an equalizer which brings one door up and then laps the other under it, making a tight bottom for crushed stone, gravel or sand. The draw bar is braced with a saw-tooth brace which does away with pins and levers, to find and hold the draw bar in the center. This saw-tooth brace is the hounds (so to speak) of the pole.

There are two different ends to these cars. One end is called the flexible end. This is also the end to be fastened to the tractor where more than one cart is used. This same end takes care of all the up-and-down of the load or all the pull.

It also takes care of the perfect alinement of the train when it is reversed in direction. There are no pins to shift when the direction of the train is changed.

This flexible end of these carts with the saw-tooth brace, cares for all the adjustments for uneven ground or road bed, also cares for the necessary adjustment when one cart is in a hollow and the other on a knoll, and finally makes the train reversible without pins or levers. This device on the flexible end, as well as the equalizer bar on the ridged end, have applications for patents pending.

Shallow Excavation by Steam Shovels

Steam shovels are being advantageously used on shallow excavation, for street and road construction in many sections of the country.

The city of Minneapolis, Minn., is using three revolving shovels on street surface excavation work preparatory to paving. On one of these jobs, on which a very hard, dense clay, mixed with boulders, was encountered, a Thew revolving shovel was used with the following results:

LABOR.

One engineer	$6.00	
One fireman	2.50	
Two laborers at $2.50	5.00	
Total labor cost		$13.50

FUEL.

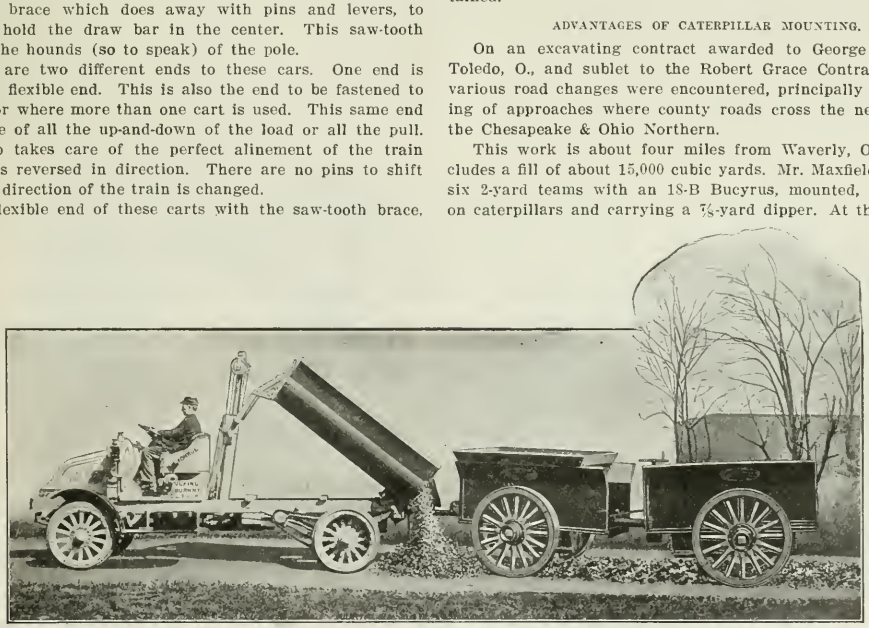
Coal, ½ ton at $6	$3.00	
Oil, grease and waste	0.15	
Repairs and overhead charges	1.05	
Total fuel cost		4.20
Total cost of excavating 250 cubic yards		$17.70
Cost of excavation 1 cu. yd. $17.70/250		0.07

The above table, giving average cost of excavation for an eight-hour day, shows 7 cents to be the average cost of 1 cubic yard of excavated material in the wagons, ready for haulage to the dump. An inspection of the data shows that an average hourly excavation of 31¼ cubic yards was attained.

ADVANTAGES OF CATERPILLAR MOUNTING.

On an excavating contract awarded to George Maxfield, Toledo, O., and sublet to the Robert Grace Contracting Co., various road changes were encountered, principally the building of approaches where county roads cross the new line of the Chesapeake & Ohio Northern.

This work is about four miles from Waverly, O., and includes a fill of about 15,000 cubic yards. Mr. Maxfield is using six 2-yard teams with an 18-B Bucyrus, mounted, as stated, on caterpillars and carrying a ⅞-yard dipper. At the present



MOVING SHOVEL *to the work. S. B. Van Wagenen, Inc., Contractors.*

time the shovel is obtaining the material for the fills from the railroad grade near by. The caterpillar method of mounting was adopted because of the large number of shallow cuts and the consequent necessity of frequent and otherwise slow and costly moves.

DIFFICULT MATERIALS ENCOUNTERED.

Instead of using scraper methods in construction of macadam roads near Lake Placid, N. Y., S. B. Van Wagenen, Inc., contractors, are using a 14-B Bucyrus shovel with a ¾-yard dipper. According to the statement of Mr. C. C. Donahue, material handled is, as a whole, difficult to excavate, consisting for the most part of boulders and hardpan with a very little earth mixed in. The cut carried has run from two to eight feet and the shovel has averaged about 300 cubic yards per ten-hour day, which is considered good under the circumstances. On this work, two 5-ton White trucks, used in the hauling of stone from the crushing plant, have replaced five teams formerly engaged in the same work. On another section of this same contract a White truck is also used. The service of the White truck on this contract is most interesting. Besides the duty above mentioned three trips a day are being made with coal averaging 5.7 tons per load. In addition, it is used for carrying men and supplies to and from the work. Mr. Marshall estimates that it saves them $15 per day.

SHOVEL IN SHALLOW EXCAVATION. *Clinton Contracting Co., Contractors.*

replacing eight two-horse wagons on hills. It has not been used for taking the excavated material from the shovel, but there are many places where its use for this purpose would be very economical.

SHALLOW STREET GRADING IN NEW JERSEY.

We are illustrating, also, an unusually shallow piece of street grading recently completed in West New York, New Jersey. The work was handled by the Clinton Contracting Company of West Hoboken, N. J., John Murphy, secretary; Joseph Murphy, general manager.

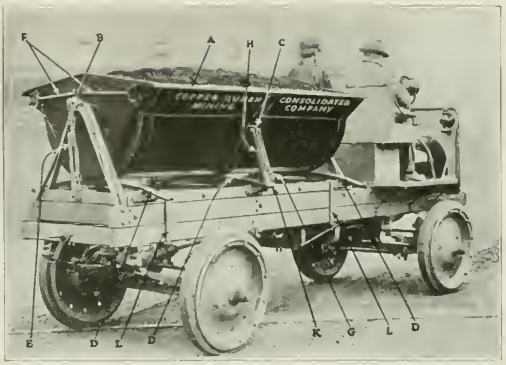
In the past, contractors have been somewhat skeptical as to the feasibility of doing a piece of grading as shallow as this with a revolving shovel, and doing it in an economical manner. Mr. Murphy used an 18-B Bucyrus revolving shovel equipped with a ¾-yard dipper with an outfit of dump wagons.

The material handled was hard-pan and macadam. The dump was about 300 feet from the shovel. The street averaged 30 feet in width, and the depth of cutting ran between two and eight inches, or an average of six inches. Under these conditions the shovel averaged about 150 cubic yards per ten-hour day. About a ton of hard coal was used per day.

REQUIREMENTS IN MOUNTAINOUS DISTRICTS.

State and county road construction invariably requires a succession of moderate cuts ranging from a few inches to a few feet, in order to bring the road to grade. Here a smooth level floor is essential, especially if paving is to follow, or the result will be an uneven settling giving the roadway a wavy surface. Time and again the ability of the revolving shovel to live up to these requirements and to do the job economically, has been proved. Shallow cuts as low as two to eight inches are being dug economically. Many roads are now being cut thru rough, mountainous country. Here the revolving shovel is proving its worth; towit: the state road work in California and the county road construction in the Adirondacks in New York. The revolving shovel not only has sufficient power to dig boulders and rock formation and overcast on side hill work, but is sufficiently portable to be moved over rough country with comparative ease. We know of one case on state road work in Pennsylvania where, unassisted, a steam shovel propelled itself up a grade of 30 per cent. An illustration shows a steam shovel on State road construction near Baltimore, Md., for the Maryland State Roads Commission which was handled by Barber & Bonner, Inc., of New York. The shovel, equipped with a ¾-yard dipper, moved in

SHOVEL IN SHALLOW EXCAVATION. *Maryland State Roads Commission. Barker & Bonner, Inc., N. Y., Contractors.*



LEE DUMP BODY, *Showing Body Secured in Position.*

all about 30,000 cubic yards of material, which was handled by locomotive and cars, wagons and automobile trucks, as conditions demanded. Mr. H. O. Barker, president, writes as follows in reference to this work: "Considerable shallow cutting from 12 to 20 inches was done with the shovel on this contract and the digging was performed in a most economical manner. No difficulties were experienced during the entire work and in every way the shovel proved most satisfactory."

Lee Dump Body on Quad

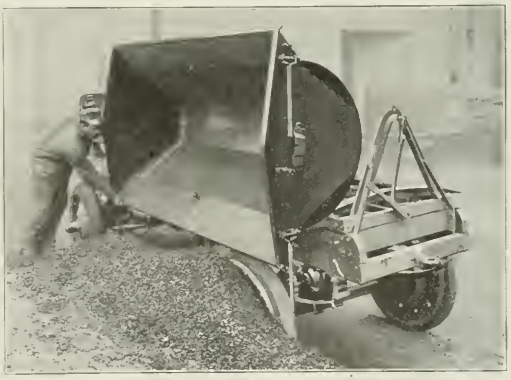
The photographs herewith show the operation of the Lee two-way side-dump body as used on the Jeffery Quad. The body is secured in position by catch, a similar catch in the front, an eccentric stop and a similar stop at the other side, as well as by the three rails on which it rolls in dumping. Each of these rails slopes away from the center line of the chassis to each side and terminates in a hook which acts as one of the final pivoting points when the body is being dumped.

The act of dumping is performed as follows: The handle in the middle of the body is raised, thus releasing the eccentric stop. The support is now free to move outward, so the operator now pulls the handle toward him and allows the support to hang downward from the hinge. This operation takes only a second or two. Then the operator grasps the handle and pulls it sideways, one way or the other, thus releasing the catch and a similar catch in front, to which it is connected by a longitudinal rod. This, also, takes but a second or two. The body is now ready to be dumped, which is done by pulling out one of the handles and pressing on it easily until the body rolls over on the rails, the distance thru which it rolls being governed by the length of the restraining chains under the body. Usually the operator dumps and rolls back the body with the same motion, altho in these pictures he did not do so. Instead, he walked to the other end of the body in order not to obstruct the view of the camera. The support and the catch are now quickly replaced, both front and rear catches being operated at the same time by either the handle or the similar one at the front of the body.

In a series of tests at the Jeffery factory, it was proved that the average driver could jump down from his seat, dump the load, replace and secure the body and return to his seat ready for driving off, in half a minute. An expert can do it in from twenty to twenty-five seconds.

The Quad was originally designed and built to replace the four-mule team in the United States army. The term "quad" is an abbreviation of "quadruple drive." The power of the motor on this truck is applied to all four wheels. Also, to aid in maneuvering in tight places and to make the rear wheels track with the front wheels, the steering device works on both front and rear wheels. Quick stopping is provided by brakes on all four wheels and on the drive-shaft.

The results of this advanced construction is a truck which easily negotiates mud, sand, gravel and difficult grades which are impassable to the ordinary type of rear-wheel-drive trucks.



LEE DUMP BODY *May be Dumped and Rolled Back With One Motion.*

LEE DUMP BODY, *Showing Three Rails on Which Body Rolls When Dumping.*

The success of the truck in the United States army was so immediate and sensational that there quickly sprung up a big demand in the contracting field.

Trade Publications

The annual report for 1914 of the Mexican Petroleum Co., Ltd., of Delaware and its subsidiaries, the Mexican Petroleum Co. (Cal.) and Huasteca Petroleum Co., has been received. In addition to the financial report showing a large profit for the year it gives a historical sketch of the development of the company's oil lands near Tampico, Mexico, which include more than half the oil lands yet located in Mexico. In addition to works at Tampico, the company have large refineries at New Orleans and were developing plants at other localities in the United States when the war conditions in Mexico made it impossible to get their product out as rapidly as desired and delays progress upon plans on which work had been begun.

The Chamber of Commerce of Vandalia, Ill., is distributing copies of the resolutions passed by it deploring the delay in settlement by the insurance companies of the fire loss of the Ford Mfg. Co., in March, 1913, the insurance amounting to $647,000.

The Universal matchless sewage spraying nozzle is shown with results of comparative tests in a circular of the Snow & Petrelli Mfg. Co., New Haven, Conn.

The Troy Wagon Works Co., Troy, O., sends a strikingly illustrated circular of the Troy Ajax dump wagon.

Kissel-Kar trucks are shown in full detail in a handsomely illustrated booklet issued by the Kissel Motor Car Co., Hartford, Wis.

Reinforced concrete bridges of Luten design in large numbers and in both black and colored plates are shown in a sumptuous book issued by Daniel B. Luten, designing and consulting engineer, Indianapolis, Ind.

The American Rolling Mill Co., Middletown, O., issues a variety of booklets and circulars on Armco iron, rust-resisting products and their uses in defeating rust, which makes very interesting reading.

The Clip Bar Mfg. Co., Philadelphia, Pa., have a galvanized curb guard, which they describe in a recent circular.

The Owen Bucket Co., Cleveland, O., describe their products in a booklet under the title, "The Business End of the Rig."

"Constant Current Transformers for Mazda Street Lighting Systems" and "Novalux Street Lighting Units for Mazda Series Lamps" are the titles of two booklets of the General Electric Co., Schenectady, N. Y., which are of value in connection with the newer systems of street lighting.

The De Laval Steam Turbine Co., Trenton, N. J., have produced a very valuable, 8-page booklet on the cost of pumping water with a diagram and separate steam scale and a chart for determining pipe resistances, which should be in the hands of every engineer.

The De La Vergne Machine Co., New York, in their bulletin No. 142, give the details of their oil engine, type DH.

Richmond screw anchors in concrete dock construction are shown in a circular of the Richmond Screw Anchor Co., New York.

The Blaw forms in sewer, tunnel, dam, wall and building work are illustrated in a circular of the Blaw Steel Construction Co., Pittsburgh, Pa.

Engineers' Bulletins 1, 2, 3 and 4 of the California Glazed Cement Pipe Co., Los Angeles, Cal., give experience with and results of tests of concrete pipe.

A table published by H. W. Clark Co., Mattoon, Ill., compares water, labor and cost for testing by single meter outfit and by their 3 and 6-meter, multiple testers.

The Turbine Sewer Machine Renovating Co., Milwaukee, Wis., have a number of interesting circulars descriptive of their apparatus for cleaning sewers and water pipes and giving the results in many places where it has been used, which are well worth sending for.

A paper on asphalt, its history, manufacture and uses read before the Brooklyn Engineers' Club by Charles Ekstrand, M. E., pays special attention to Montezuma asphalt and is reprinted by Warner-Quinlan Asphalt Co., New York.

The advantages of using one of the various styles of Studebaker dump wagons are briefly and clearly set forth in a mailing circular of the Studebaker Corporation, South Bend, Ind., No. A 895.

The Clark meter coupling yoke for use in setting water meters in Clark meter boxes is shown in operation and fully described in a circular of H. W. Clark Company, Mattoon, Ill.

The Chicago Pneumatic Tool Company are now distributing their Bulletin No. 216, covering their Hummer self-rotating type hammer drills, which are made in three sizes, known as the A-66, B-66 and C-66 drills, suitable for drilling 6, 8 and 12-foot holes, respectively. Among the important features which the manufacturers have incorporated in their drills is that of the rotation of the steel being entirely independent of the hammer piston, eliminating the use of ratchet or pawl parts which is the common means used in other drills. This means a much more rapid drilling machine, as the piston is free to deliver the full force of its blow upon the drill steel without losing a part of its power through the necessity of rotating the steel as well. Another important feature of the Hummer drill is the valve which consists of a standard commercial hardened steel ball ordinarily used for ball bearings. It is three-quarters of an inch in diameter and weighs a trifle over an ounce. Its travel between its seats in the valve chest is only one-eighth of an inch. It is perfect in its action, practically indestructible and ideally simple as compared with other rock drills mechanisms. For further details of this drill and bulletin, address the Chicago Pneumatic Tool Company, 1010 Fisher Building, Chicago, Ill.

The Atlantic Refining Co., of Philadelphia, has reprinted the paper before the Pan-American Road Congress in Oakland, Cal., by Wm. D. Uhler, chief engineer of the Pennsylvania State Highway Department, on resurfacing of old roads, supplementing it with an illustrated description of resurfacing and surface-treating 1,200 miles of road in four months at minimum cost. It will be sent on request and is well worth careful study as giving excellent instruction on road maintenance.

View 1—Looking down General Lee Street from intersection of Dolores Street, Marianao, Cuba. View taken April 1915. Plain macadam laid in October 1914. Note destruction of gutters by tropical rains.

View 2—Looking up General Lee Street from intersection of Dolores Street, Marianao, Cuba. View taken April 1915. Tarvia macadam Laid in August 1914.

Tarvia versus Tropical Rains

HERE is a street in Marianao, Cuba, which was paved with plain macadam.

View 1 shows what it looked like six months later with the gutters all washed out by the tropical rains, so that the two sides of the road were mere heaps of broken stone.

View 2 shows an adjoining section of the same street which was paved with Tarvia macadam a short time previously. But after six months, as the view shows, the tarviated-macadam was just as good as new and the heavy rains had not injured it a particle.

The relative superiority of Tarvia shown in this test in Cuba holds good for this country except that the contrast will not be so promptly shown. Nevertheless the superiority of tarvia-bonded macadam is speedily apparent.

To be sure, tarvia-macadam costs a little bit more to build than plain, water-bonded macadam, but it lasts so much longer and requires so much less maintenance that the extra first cost is more than repaid.

Tarvia
Preserves Roads
Prevents Dust

In the long run plain macadam is very expensive because it was not designed for modern automobile traffic and quickly disintegrates when its tender surface is subjected to twentieth century traffic.

Booklets discussing the road problem in detail, on request. Address our nearest office.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria

THE PATERSON MFG. CO., Limited: Montreal Toronto Winnipeg Vancouver
St. John, N. B. Halifax, N. S. Sydney, N. S.

CONTRACTING NEWS

AUTOMOBILES. FIRE APPARATUS.

Cleveland, Tenn.—Purchase of new equipment for fire department being considered. T. C. McCamey, Fire Chf.

Pine Bluff, Ark.—Purchase of auto fire truck early next year planned. Simon Blume, Mayor.

Racine, Wis.—Following bids received for combination hose and chemical auto truck and chemical truck. International Motor Co., Chicago, $5,245 and $4,745—$500 allowed for old horse-drawn hose wagon. White Auto Co., Cleveland, Ohio, $5,000 and $4,500—$500 allowed. Robinson Fire Apparatus Co., St. Louis, Mo., $5,500 and $5,250—no allowance. American-La France Co., Elmira, N. Y., $5,500 and $4,750—$500 allowed. Seagrave Co., Columbus, Ohio, $5,250; if 6-cylinder motor is required $5,500—$350 allowed. Sterling Motor Co., Milwaukee, $3,800—no allowance. For chassis—Electrical Constr. Co., Racine. Mitchell chassis $1,635; Cole Motor Co., Chicago, $1,185; Jonnes Auto Co., Milwaukee, $2,042.70 and $2,072.55; White Automobile Co., Cleveland, $2,179. Jas. Cape, Fire Chf.

Springfield, Mion., Jan. 18th, until 7:30 P. M. bids will be received for 500 ft. rubber treated fire hose. S. J. Fernholz, City Recorder.

Westfield, N. Y.—Purchase of 2 auto fire trucks authorized. Address Village Trustees.

BRIDGES.

BIDS REQUESTED.

Deadwood, S. D.—Jan. 5th, for concrete walls, culverts, bridge abutments and other concrete work required during 1916. e. c. $100. Fred Harris, Co. Aud.

Knoxville, Iowa.—Until Jan. 18th, for county bridge work as follows: 4 truss spans, 18 beam spans and 90 reinforced concrete box culverts. Total cost, $85,000. W. O. Price, Co. Engr.

LaPorte, Ind.—Jan. 13th, until 10 A. M., for several bridges in La Porte Co. F. A. Hausher, Aud. La Porte Co.

York, Neb.—Jan. 11th, until noon, bids will be received for steel and concrete bridges in York Co. during 1916. A. H. Beck, Co. Clk.

CONTRACTS AWARDED.

Bloomington, Ill.—Contract awarded Porter & McCully Co., Mackinaw, Ill., for bridge over Mackinaw river near Lexington at $12,912.

Norfolk, Va.—To Alsop & Pierce, city, bridge over Lafayette river on James Blvd. at $28,367.

Philadelphia, Pa.—To The Catrell Constr. Co. city, Diamond St. bridge over Pennsylvania R. R. at $69,754.

Stevenson, Wash.—To Const Bridge Co., Portland, Ore., steel bridge across Wind river in Skamania Co. at $12,130.

CONTEMPLATED WORK.

Indianapolis, Ind.—Bridge across White river on Maple drive near Center-Washington Twp line being urged. Estimated cost $350,000. Address Comnrs. of Marion Co.

Montgomery, Ala.—Bridge across Tombigbee river being considered by Clark and Washington Co. Comnrs. W. S. Keller, State Highway Engr.

Ottawa Ill. Bond issue of $85,000 voted for Shippinsport bridge in LaSalle Twp. Address Twp. Highway Supt.

Scranton, Pa.—Steel and concrete bridge across Lackawanna river between boroughs of Olyphant and Dickson to be considered. Estimated cost $2,000. Address Co. Comnr.

Walla Walla Wash.—Bridge across Snake river between Burbank and Pasco favored. Cost not to exceed $50,000. Chas. F. Fowler, Consulting Eng., Seattle. H. A. Reynolds and J. A. Royals, Co. Comnrs.

Westchester, Wash.—Plans being prepared for steel bridge near Wenatchee river at Wenatchee Ave. Fred A. Warren, Co. Engr.

White Plains, N. Y.—Plans being prepared for county bridge over Bronx river between Yonkers and Tuckahoe; cost not to exceed $15,000. Also for county bridge over Croton river at Hammond; cost about $30,000. Address Bd. of Supervisors.

BUILDINGS.

BIDS REQUESTED.

Ogden, Utah—Jan. 8th, until noon, for Isolation Hospital on county property north of city limits. Shreeve & Madsen, Archts. 215 Hudson Bldg. Harry Hines, Co. Clk.

Oneida, Iowa.—Until Feb. 1st for 2 story 70x50 ft. school bldg. Harry Eames Netcott, Archt., Independence.

Sioux City, Iowa.—Feb. 7th, until 2 P. M., for court house building. W. L. Steele, Archt., 502 United Bank Bldg., city. E. E. Hosner, Co. Aud.

Toledo, Ohio.—Until Jan. 10th, for alterations and additions to Ironville school on Milford and Tiffin Aves. Edward N. Gee, Archt. Board of Education.

Tuscola, Ill.—About Mar. 15th, for 2-story high school. Estimated cost $125,000. C. C. Kagey, Secy. Twp. High School Board.

Wheaton, Ill.—Jan. 14th, until 8 P. M., for 4-room school bldg. c. c. 5 per cent. of bid. W. H. Monroe, Pres. Bd. of Educ. School Dist. No. 6.

CONTRACTS AWARDED.

Batavia, Ohio.—To A. T. Edeland, Miamisville, Ohio, general construction of high school building at $23,706.

Cleveland, Tenn.—To Cleveland Constr. Co., city. Bradley Co. high school bldg. Contract price including plumbing and heating, $25,-181.

Coffeyville, Kans.—To Brewster & Brewster, city, general contract for 2 additions and an 8-room school at $28,760.

Columbus, Ohio.—To Winters & Wilson, Strausburg, grade and high school bldg. for Monroe Twp. Preble Co. at $38,588.

Houston, Tex.—To Woodruff & Chambers, general construction for administration bldg. of Montrose school at $14,914.20.

Kansas City, Mo.—Contract awarded Flannigan Constr. Co., city, for Walnut St. and Southwest Blvd. police station, at about $36,-000.

North Adams, Mass.—To. H. C. Wood & Co., city, general contract for high school bldg. at $144,860.

Paterson, N. J.—For constructing school No. 10 as follows: To Cona Constr. Co., mason work at $51,862; to Jas. Mitchell, Inc., concrete work at $52,535; to Livingston-Stewart Co., structural steel work, at $17,500; to Cona Constr. Co., carpenter work, at $24,067.

Peoria, Ill.—To W. F. Benson, city, Irving school, at $23,990.

Putnam, Conn.—To Doyle & Murphy, Hartford, Conn., trade school bldg., at $14,450.

Stafford, Ariz.—To Lescher & Kibby, Phoenix, court house and jail, at about $44,-000.

Wheeling, W. Va.—To J. R. Butts & Son, city, Madison school on Island, at $75,019.

CONTEMPLATED WORK.

Amsterdam, N. Y.—Plans being made for 2-story fire proof school bldg. on Vrooman Ave. Estimated cost $35,000. L. Niles, Archt. Amsterdam.

Brea, Cal.—Bond issue of $70,000 voted for 2-story 10-room school bldg. Plans being prepared by E. R. Jeffry and Frank R. Schaefer, Archts., 1202 Van Nuys Bldg., Los Angeles.

Brookston, Ind.—Contract will be let about Jan. or Feb. for 2-story 70x120 ft. brk. high school. Elmer E. Dunlap, Archt., Indianapolis, Ind.

Brownsville, Tex.—Bond issue of $100,000 for school bldgs. voted recently. Plans being prepared for 3 school buildings. Address Board of Trustees of Independent School Dist.

Buffalo, N. Y.—Addition to school No. 1 on 7th. St. planned. Probable cost $13,000. Address Board of Educ.

Butler Pa. Movement started for constructing hospital for insane. Estimated cost $300,000. S. C. Moore, Comnr. Mercer Co.

Crawfordsville, Ind.—City building costing about $30,000 being planned. J. D. Murphy, City Attorney.

Delphi, Ind.—Plans being prepared for 3-story court house for Carroll Co. Estimated cost $200,000. Elmer E. Dunlap, Archt., 909 State Life Bldg., Indianapolis.

Dover, Ohio.—Plans being prepared for school bldg. H. C. Wurmser, Archt., Lorain, Ohio.

Harrisburg, Pa.—New Central high school bldg being considered. Dr. C. E. L. Keene, Pres. Bd. of School Dir.

Jersey City N. J.—Plans being made for 5 school buildings. Work to be started in spring. Mr. Fagan, Mayor.

Jennings, La.—Plans being prepared for court house for Jefferson Davis Parish. Estimated cost $75,000. W. L. Stevens, Archt., Baton Rouge.

Kingston, Tenn.—Site selected for high school bldg. Probable cost of handling $13,-000. Address Board of Educ.

Lancaster, Pa.—Plans being prepared for 3-story high school. Estimated cost $150,000. C. E. Urban, Archt., Woolworth Bldg.

Lubbock, Tex.—Plans being prepared for 3-story court house to cost about $100,000. Rose & Peterson, Archts., Kansas City, Kans.

Mobile, Ala.—Bond issue of $150,000 for county schools will be voted on Jan. 18th. Address Comnrs. Mobile Co.

Mound, Minn.—Preliminary plans being prepared for 2-story consolidated school. Estimated cost $60,000. D. Wilkins, Secy. Bd. of Educ. F. E. Halden, Archt., 601 Kasota Bldg., Minneapolis.

New York City—$600,000 appropriated for addition to Kings Co. court house. Address Bd. of Estimates.

Oswego, N. Y.—Plans being made for new high school. Probable bond issue $200,000. Address Bd. of Educ.

Portland, Ore.—Contract for grade school to cost about $200,000 will be let early next year. Addition to Franklin high school to cost $120,000 contemplated. Address Bd. of Educ.

Port Washington, L. I., New York.—Bond issue of $11,000 will be voted on Jan. 7th for addition to high school. John Hutchinson, Clk. Bd. of Educ.

Richmond Hill, N. Y.—New school bldg. at Hillside and Sherman Aves. being urged. Edgar Dubbs Shimer, Dist. Supt.

Secaucus, N. J.—Addition to school No. 1 on Central Ave. planned. Probable cost $45,-000. Address Bd. of Educ.

Syracuse, N. Y.—Purchase of sites for 4 new school buildings authorized. Address Bd. of Educ.

Terre Haute, Ind.—Bids will be received in February for 3-story grade school known as McLain school. Estimated cost $115,000. Herbert W. Foltz, 1456 Lemcke Annex, Indianapolis, Archt.

Tifton, Ga.—Bond issue of $100,000 for city hall will be voted on. W. W. Banks, Mayor.

Tiro, Ohio.—Bond issue of $40,000 for consolidated school for dist. including Auburn Twp., Maple Grove special, DeKalb special and north part of Vernon Twp. will be voted on Jan. 24th.

Torrington, Conn.—School bldg. for western part of city being considered. Geo. J. Vogel, School Supt.

Wilmington, Ohio.—Plans for Clinton Co. court house submitted. Estimated cost $350,-000. Address Co. Comnrs.

Yonkers, N. Y.—Plans being made for county hospital. G. Howard Chamberlain, preparing plans and specifications.

LIGHTING.

BIDS REQUESTED.

Elkhart, Ind.—Until Jan. 11, bids will be received for street lighting system. Contract divided into 3 parts. 1 for installation of system, 1 for maintenance and 1 for furnishing power. Lawrence W. Russell, City Engr.

Janesville, Wis.—Jan. 11, until 2 p. m., for furnishing c. o. b. Janesville 125 to 135 light standards for proposed lighting system. Jas. A. Fathers, Pres. Bd. of Public Works.

CONTEMPLATED WORK.

Decatur, Ala.—Municipal electric light plant planned. Jas. A. Neyson, Mayor.

Ruskin, Neb.—Bond issue of $6,000 voted for electric light system.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Albany, N. Y.—Until Jan. 11, for constructing 2 connecting highways. Much road to James st. and Whitesboro to Mill st., in city of Rome. W. W. Wotherspoon, State Supt. of Public Works, Albany.

Dadeville, Ala.—Until Jan. 12, for 38 miles highway construction. Address Co. Commrs.

Eastview, Ohio—Jan. 17, until noon, for grading, draining, curbing and paving Eastview ave., from Kinsman rd. to S. Moreland blvd., with brick, concrete, asphalt or bituminous macadam, and constructing sidewalks, C. c. 10 per cent. of bid. Chas. E. Berger, Village Clk.

Evanston, Ill.—Jan. 17, until 8 p. m., for 29,900 sq. yds. and 41,400 sq. yds. brick pavement on concrete portions of various streets. C. c. 10 per cent. of bid. H. P. Pearsons, Pres. Bd. of Local Impvts.

Rockford, Ala.—Until Jan. 11, for grading and top soiling Rockford and Kellyton rd., about 4.5 mi. Address Co. Commrs.

Sault Ste. Marie, Mich.—Jan. 13, until 3 p. m., for 2 roads, 5,080 ft. and 7,100 ft. in length. Bids on macadam and concrete. H. A. Osborn, Co. Road Comnr.

St. Louis, Mo.—Jan. 7, until noon, for paving and constructing sidewalks on Union ave. viaduct. Deposit required, $625. E. R. Kinsey, Pres. Bd. of Public Service.

Wallace, Idaho—Until Jan. 15 for street paving in Dist. No. 4. Robert Merriam, City Engr.

Here's the Solution of your Old Macadam Roads—Surface them with

BITULITHIC

Bitulithic surface has been used to a great extent for surfacing macadam roads in a number of cities with most gratifying results.

Bitulithic Pavement. Intersection N. Main and Church Sts., Court St. in background, Herkimer, N. Y. Church St. laid on 4-inch Concrete base 1908.

Bitulithic surface can be laid on old macadam and give entire satisfaction.

It is false economy to keep repairing your old macadam roads when by using the old macadam, the usefulness of which as a road for travel has past, as a foundation for the **Bitulithic** pavement you save the expense of laying a new concrete foundation and stop the large maintenance cost you now expend yearly.

It is cheaper to have a good, substantial, bituminous surface in the beginning than to have a cheap, inferior construction which has to be repaired within a year or two after it is laid.

Many cities have found this out, and over 340 cities throughout the United States and Canada have adopted **Bitulithic** as the standard pavement for their streets.

Let us give you the benefit of our many years' experience in the street paving industry.

BITULITHIC *once* — BITULITHIC *always*.
It is the Pavement You are Looking For.

WHY NOT BUILD FOR ALL TIME WHEN IT COSTS VERY LITTLE MORE?

SPECIFY BITULITHIC

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CONTRACTS AWARDED.

Buffalo, N. Y.—To German Rock Asphalt & Cement Co., Morgan Bldg., asphalt pavement on Peckham st., at $13,140.

Charlotte, N. C.—To A. H. Guion, Gastonia, 17,500 sq. yds. sidewalk construction, at $20,-050.

Dallas, Tex.—To Standard Engineering & Constd. Co., city, Uvalde rock asphalt pavement on Bishop ave., at $15,023.20.

Excelsior, Minn.—To the Oakes Construction Co., Minneapolis, paving work. Bid, $2.83 per sq. yd. for 3.5 in. creosoted long-leaf yellow pine blocks and 38 cents per ft. for concrete curbing.

Hackensack, N. J.—To Franklin VanReden, East Rutherford, improvement of Meadow rd. and Rutherford ave., at $18,560.

Liberty, Tex.—To N. A. Dawson, San Antonio, road building in Liberty Twp., at about $25,000.

Manhattan Beach, Cal.—To Municipal Improvement Co., Richmond, 6,634 ft. concrete sidewalks and 35,775 sq. yds. concrete pavement, at $13,954.

Ontario, Cal.—To Jas. L. Frazer, Long Beach, street paving to include 4-in. concrete base, 3/8-in. asphaltic oil wearing surface, grading, etc., at $44,517.

Philadelphia, Pa.—To Union Paving Co., city, surfacing Tyson st. and repaving of Terrace st., at about $32,300.

Sioux Falls, S. D.—To Warren Bros. Co., Boston, Mass., bitulithic pavement on Main ave., at $2.10 per sq. yd.

Spokane, Wash.—To S. G. Kinder, Bridgeport surfacing 12 mi. Sunset highway with gravel at $7,568.60; to H. L. Wilson Co., Walla Walla, grading 11.5 mi. Inland Empire highway, at $16,945.85; to General Constr. Co., grading 9 mi. Inland Empire highway, Rosalia to Oakesdale, at $21,646.45; to G. L. Stickler, Davenport, grading 8¾ mi. and 9.5 mi. of Inland Empire highway, at $23,887.30 and $22,639.

Warrensburg, Mo.—To J. W. Menafee, Sedalia, Mo., vertical fiber brick block pavement on 4-in. concrete base, at $12,600.

CONTEMPLATED WORK.

Abingdon, Va.—$18,000 bonds sold for road constr. in Washington Co. Address Bd. of Supervisors.

Canton, Ohio—Paving of Cairo-Hartville rd. with brick authorized. Work to be done next summer. Probable bond issue, $125,000. Address Co. Comnrs.

Council Bluffs, Iowa—Estimates and surveys being made for paving Ave. A, from 13th st. to 37th st. Mr. Speham, City Engr.

Danville, Ill.—Bond issue of $1,500,000 voted by Vermillion Co. 2 yrs. ago held legal. Plans made for 174 mi. of paved road, connecting every town and village around Danville. All survey work for entire system completed. Address Co. Comnrs.

Eldora, Iowa—Contract will be let about Feb. for 12 blocks concrete, bitulithic or asphaltic concrete pavement, with cement concrete curbs. L. J. Stout, City Clk.

Fairmount, Minn.—About $55,000 will be expended next season for road bldg. Geo. A. Taber, Dist. Engr. of Highways.

Hastings, Neb.—Preliminary plans made for 11 miles street paving. Mr. Fuller, City Engr.

Hillsboro, Ore.—Resurfacing Hillsboro-Forest Grove rd. with oil-bound macadam planned. Probable cost, $21,000. Address Comnrs. Washington Co.

Indianapolis, Ind.—Paving of Emerson ave., for distance of 5.6 mi. petitioned for. Increase in width from 30 ft. to 60 ft. also asked for. Address Marion Co. Comnrs.

Jackson, Minn.—About $40,000 will be expended for road improvements next season, to include one 50-ft. span steel bridge. W. E. Matters, Dist. Engr.

Joliet, Ill.—Brick pavement on Cass st. planned. Estimated cost, $32,987. C. D. O'Callahan, City Engr.

Joplin, Mo.—Ordinance passed for paving 10 blocks of 6th st. Huch McIndoe, Mayor.

Luling, Tex.—Bond issue of $50,000 for road construction in Luling Dist. will be voted on Jan. 22. Address Comnrs. Caldwell Co.

Missouri Valley, Iowa—Plans being prepared for about 40,000 sq. yds. brick bit., concrete vertical fiber brick inevin or bituthic pavement on 4-in. concrete base. Contract will be let about Feb. 1. Price & McCormack, Civil Engrs., city.

New Philadelphia, Ohio—10 miles of improved roads inproved by Co. Comnrs. Contracts to be let in Feb. Address Co. Comnrs.

Olympia, Wash.—Paving to cost about $11-000 will be awarded early next year. J. B. Wedell, City Engr.

Omaha, Neb.—Paving of Ave. A planned. Preliminary cost based on paving with concrete 40 ft. wide, $119,576. J. V. Hosford, City Engr.

Painesville, Ohio—Improved road thru Willoughby Twp., by way of Pleasant Valley, and thru Kirtland Twp., being urged. Probable cost, $32,000. Address Comnrs. of Lake Co.

Portland, Ind.—Paving of E. 7th st. and Boundary pike within city limits with brick, recommended. Estimated cost, $26,108.50. C. A. Paddock, Mayor.

Portland, Ore.—Macadamizing of Skyline blvd., also known as Hornell Mountain rd. extension, petitioned for. Address Co. Comnrs.

Princeton, Ill.—Resolution adopted for brick pavement on several streets. Estimated cost, $93,635. M. L. Parker, City Engr.

Queensboro, New York City—Resolutions adopted for grading, curbing and constructing sidewalks in Queens blvd., thru Long Island City, Woodside, Winfield, Elmhurst, Forest Hills and Jamaica. Estimated cost, $1,360,-000. Morris E. Connally, Pres. Queensboro.

Seattle, Wash.—Grading 32nd ave., West, estimated cost, $119,500, and paving 9th ave., West, and Holliday st., with asphalt, estimated cost, $8,600, planned. A. H. Dimock, City Engr.

Sweet Springs, Mo.—Establishment of district to rock surface 8 miles of road planned. Estimated cost, $50,000.

Tucson, Ariz.—Plans being prepared for mountain resort road, length about 19 miles, and commercial roads, by W. C. Gootz, Co. Engr. Estimated cost, $100,000 and $300,000, respectively.

Waelder, Tex.—Bond issue of $75,000 for building link in San Antonio-Galveston highway will be voted on Feb. 6. Address Co. Comnrs.

Washburn, Wis.—Bids will be advertised shortly for street paving for 1916, including creosote blocks, asphaltic concrete, sheet asphalt, vit. brk. and reinforced concrete.

SEWERS.

BIDS REQUESTED.

Clinton, Iowa—Jan. 11, until 8 p. m. for storm sewer in 1st st. and 4th ave. C. c., $500. Frank W. Leedham, City Clk.

Danville, Pa.—Jan. 10, until noon, for one reinforced concrete rapid sand filter of 300,000 gal. daily capacity. C. c., $200. Chester & Fleming Engrs., Union Bank Bldg., Pittsburg, Pittsburg.

Eastview, Cleveland, Ohio—Jan. 17, until noon, for storm and sanitary sewers in Eastview ave. C. c., 10 per cent. of bid. Chas. E. Berger Village Clk.

Pierce, Neb.—About Mar. 1, for installation of sewer system, to cost about $20,000. L. P. Conner, City Clk.

St. Louis, Mo.—Jan. 7, until noon, for North Baden public sewer, 1st section, sewers in Glaise creek sewer dist. No. 12, in Harlem creek sewer dist. No. 14 and for North Rock creek joint dist. sewer, in North Rock creek joint sewer dist. Deposits required, $1,543, $1,145, $465 and $580, respectively. E. R. Kinzy, Pres. Bd. of Public Service.

CONTEMPLATED WORK.

Buffalo, N. Y.—Extension of present sewer system and outlets and construction of 3 sewage disposal plants planned, by Frank C. Tolles, Dist. Engr. of International Joint Comm. Geo. H. Norton, Comnr. Public Works.

Chicago, Ill.—Extension of 39th st. sewer from Halsted rd. to Racine ave., and filling in of Bubbly creek, being urged. Probable cost, $500,000. Address Engineering Comm. of Sanitary Dist.

Clovis, N. Mex.—Bond issue of $25,000 for extension and improvement to sewer, water and light systems will be voted on shortly.

Columbus, Ga.—Better sewer system being urged by Dr. J. T. Moncrief, Health Officer. John C. Cook, Mayor.

Fresno, Cal.—Plans being prepared for storm sewer system and for additions to present sanitary sewer system. Probable cost, $150,000. Burt E. Cronkite, City Engr.

Galesville, Tex.—Bond issue of $22,500 voted for sewer construction.

Grand Rapids, Mich.—Plans completed for sewer system south of Hall st. and west of Buchanan ave. Estimated costs, $53,450 for trunk sewers, $53,360 for sanitary lateral sewers and $13,050 for storm sewers. W. S. Moore, City Engr.

Greensboro, N. C.—Bond issue of $75,000 for sewer construction voted recently. Thos. J. Murphy, Mayor.

Kansas City, Kans.—$15,000 voted for concrete covering over Splitlog sewer. Address City Comnrs.

LaGrande, Ore.—Contract will be let in January for 9,590 lin. ft. 8-in., 320 lin. ft. 10-in. and 640 lin. ft. 12-in. vit. pipe sewers. Estimated cost $15,371. L. D. Howland, City Engr.

Manhattan Boro, New York City—Rebuilding of entire sewer system, to extend over period of years, being planned. Probably $1,-000,000 will be expended each year. Marcus M. Marks, Boro Pres.

WATER WORKS.

CONTRACTS AWARDED.

Galveston, Tex.—To Isaac Heffron, city, laying of underground 30-in. cast iron water main across Galveston Bay, at about $60,000.

Houston, Tex.—To Chas. S. Banham, city, power house and settling tanks for N. Main st. pumping station, at $7,821.

Valparaiso, Ind.—To M. W. Halben, Gary, Ind., improvement to water system at $5,990.

CONTEMPLATED WORK.

Beebe, Ark.—Contract will be let in Feb. for installation of water works system, to cost about $15,000. Lund & Hill, Consulting Engrs., Little Rock, Ark.

Castle Rock, Colo.—Municipal water system, costing $40,000, being considered. Geo. H. Sethman, Engr., Equitable Bldg., Denver, Colo.

Covington, La.—Bond issue of $71,000 will be voted on Jan. 1 for water works and sewerage plant.

Cullman, Ala.—Contract for 2 miles of 8-in. water mains, to cost $12,000, will be let about April. A. G. Coe, City Clk.

DeRidder, La.—Plans being prepared for water works system. Bids to be called for in about 60 days. K. A. Kramer, Consulting Engr., Magnolia, Miss.

Farmersville, Ohio—Contract will be let about Feb. 15 for water works system. Estimated cost, $16,000. A. P. Gilbert, City Clk.

Fayetteville, N. C.—Improvement of water works system under consideration. John K. Strange, City Engr.

Fleetwood, Pa.—Plans for water works system will be completed in spring. Probable cost, $10,000.

Hutchinson, Kans.—Two-mile extension to water works system contemplated for 1916. Edward Metz., City Clk.

Johnston, S. C.—Bond issue of $40,000 for water works and sewers will be voted on shortly. W. W. Derick, Mayor.

Ridgefield, Wash.—Bids will be advertised shortly for reservoir and distribution system. Bids will probably be opened Jan. 5. Mr. Blackburn, City Clk.

Ridgefield, Wash.—Plans being made for water system. Bond issue of $11,000 voted and sold.

Seattle, Wash.—Water mains on Orcas st. and Dorris st. planned. Probable cost, $8,400. A. H. Dimock, City Engr.

St. Paul, Minn.—Improvements to water system, to cost about $500,000, being planned. Oscar Claussen, City Engr.

South Charleston, Ohio—Contract for installation of water works system will be readvertised. W. L. Wentz, Village Clk.

Swanville, Minn.—Bond issue of $9,000 for water works system voted recently. Contract to be awarded in spring. W. Anderson, Village Clk.

MISCELLANEOUS.

BIDS REQUESTED.

Hobart, Tasmania, Australia—Jan. 24, until 4 p. m., for supply and delivery of about 42,000 lin. ft. of cast iron, wrought iron or mild steel pipes. Preliminary deposit, 2½ per cent. of bid. W. A. Brain, Town Clk.

St. Paul, Minn.—Jan. 17, until 10:30 a. m., for steam pumping unit, capacity 16,000,000 gal. daily. C. c., 10 per cent. of bid. August Hohenstein, Purchasing Agent.

CONTRACTS AWARDED.

Brookville, Ind.—To John H. McGowan Co., contract for steam pump. Bid, $3,165 for triple expansion pump with 400-ft. condenser and $2,950 for same with 200-ft. condenser.

Houston, Tex.—To Jas. Stewart & Co., city, construction of sheds and railway tracks at municipal wharf No. 1, at $21,360.

Stone Harbor, N. J.—To Hill Dredging Co., Atlantic City, contract for bulkhead and jetties for ocean front protection, at $192,414.

CONTEMPLATED WORK.

St. Louis, Mo.—Ordinance passed authorizing construction of municipal dock, to cost about $285,000. Henry W. Kiel, Mayor.

Seattle, Wash.—Construction of sea wall on Railroad ave. planned. Probable cost, $75,000. A. H. Dimock, City Engr.

MUNICIPAL ENGINEERING

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EDITORIAL

PLANS FOR GOOD TIMES

The fiftieth volume of MUNICIPAL ENGINEERING will complete this year and the first number of the year indicates what the advance of the fiftieth volume over the first volume may be. Times have changed in twenty-five years and the magazine has changed with it. A new energy has shown itself in all departments of industry and it is showing itself in the conduct of this business in a manner which will become more evident as the great year of this country unfolds.

Plans have been made to serve the needs of all classes of our readers with material to suit their needs. The editor is continually asking for suggestions and any one whom he has failed to reach is invited to add his requests, which will be worked into the program as opportunity offers. The question department is always open for service to subscribers and they are invited to reciprocate with brief articles on design and construction with which they have been connected, in which others would be interested. We all of us want to know what the others are doing and how they are doing it.

The engineer is interested in the design of works, in specifications, in statements of cost which can be used as aids in making his estimates, in descriptions of new materials and methods, and as always, articles a little in advance will be found here showing what the prospects are, as well as later full descriptions of plans and of the completed work.

The operating engineer and the city official in the management of public utilities is interested in the solution of his problems of operation and maintenance and in the methods of economical management and he will find much to aid him. If his particular problem is not touched he is invited to state it and if not already in the program it will be put in.

The contractor is interested particularly in methods and costs of construction, in machinery and apparatus, and he will find the modern developments set forth in some detail.

The automobile truck, in particular, promises to be the great development of the year and the number in use will multiply rather than be added to. The series of compilations of information in this line, which has been running for several months, will be made more definite and complete as experience by more users adds to the stock of information as to methods of use, cost of operation and economy of management. Heretofore the data have been very fragmentary but the weak spots are being filled and the growing demands of contractors for reliable and detailed information about the possibilities of the new motive power and the methods of realizing them will be satisfied as rapidly and completely as possible.

The student and the engineer who is working up a subject will not be forgotten, the descriptive lists of books on municipal engineering subjects, of which one is given this month, being one indication of the service he will be given.

The news of the field will be given as only a monthly can give it, preserving the material of value and giving a birdseye view of the business of contracting and the business of engineering and the business of supplying the engineers and contractors with the materials and apparatus they require, as well as the important personal happenings and the news of the gatherings of men of the same interest together to discuss their common problems.

All together, the magazine will do its best to keep just a little in advance of the procession, no small job in a year when the movement forward will be the most rapid and the most widespread which the country has ever seen.

ROAD SCHOOLS

The brief road school in the winter which began practically with the graduate school at Columbia University, was taken up by the engineering and agricultural departments of the State universities two or three years ago and has developed into a real source of instruction for the men directly interested in the construction and repair of roads. Fully eighty superintendents, commissioners, supervisors and engineers of highways, with additional prospective employes of highway departments, attended the road school of the University of Illinois and even a larger number that at Purdue University in Indiana held in January and Michigan, Wisconsin and Iowa were not far behind. The Indiana county highway superintendents, ninety-two of them, have a State association which meets in connection with the road school. While the time spent at the school is short the instruction is special, expert, and concentrated and touches the real problems of the attendants and is productive of much good. Experience is improving the schools each year and they have become a necessity.

IMPROVEMENT OF RIVER BANKS

OF HARRISBURG, PA.

By Farley Gannett, Consulting Engineer, Harrisburg, Pa.

American cities, most of them, have been too busy to look after the beautifying of the water courses passing thru them and fell into the habit of considering them as necessary evils. Harrisburg, Pa., was one of the first cities to undertake the improvement of its water courses, large and small, and, tho a small city has made long strides toward making the banks and the streams beautiful as well as putting them in sanitary condition.

The author of this paper was directly connected with the work in some of its stages and describes it from intimate knowledge of what has been done and what is still in mind for future development.

Harrisburg has one asset, the Susquehanna River, which is greater than many cities can claim, and the pictures show how the city is first improving the physical condition of its banks, second, the stream itself and, to follow, the beautifying of the banks to conform with the beauty of the regulated stream.

MOST streams of importance in Pennsylvania are made "public highways" by law, and as such are as free to travel and use by the public as country roads or city streets. But seldom does the public care for them to keep them adequate and in proper condition as it does the streets. The average small stream which passes thru a town is foul and ill-smelling, an eyesore and breeding-place for disease; while its channel is usually too small, due to encroachments by bridges, culverts and abutting properties, to carry off floods. This is equally true of many large streams, which, instead of being agents for the promotion of industry, comfort, beauty and pleasure, are positive detriments to the towns thru which they pass. Add to this their liability to rise in uncontrolled flood, causing great destruction of life and property, and what should be an ally of inestimable value, becomes a scourge.

Factories and mills naturally seek the water's edge to obtain short intake lines to the stream or to be adjacent to the railroad. This proximity to the stream has also the "advantage" of offering a convenient dumping ground for waste material, which, when thrown over the bank, are washed away by the floods (leaving room for a fresh supply) to form shoals at points below. Where there are no railroads or industrial works, it is most astonishing that civic pride and economic considerations do not cause advantage to be taken of the potential beauties and uses of the streams. But even when these drawbacks exist, the banks and channels can often be attractively improved.

There is seldom any such attempt to control and guide the flow of water in streams other than the irregular banks as nature made them and as man has encroached upon and narrowed the channel without regard to the necessities of the situation. But when the stream flow is obstructed the only alternative for flood water is to rise out of the channel and pass thru the town carrying devastation with it, as did Mill Creek, at Erie, Pa., on August 3, 1915.

Two striking examples of stream treatment and lack of treatment by Pennsylvania cities may be cited. One, where nothing was done and the loss of thirty-four lives and $2,000,000 of property resulted. The other, where a few hundred thousand dollars has not only prevented such an occurrence, but has converted the waterways which pass by and thru the city into valuable assets. The one is Erie, the other Harrisburg.

In the night of August 3, last, Mill Creek, which passes for nearly three miles thru the heart of Erie, rose in flood and tearing out over a score of bridges, 200 houses and other buildings, laid waste an area of two and a half miles long and from one to three blocks wide. Corrective measures are now being planned and will probably be adopted, for twice before has similar, altho not so extensive, damage been wrought by this stream.

Previous to 1902, Harrisburg, the capital city of a great state, beautifully situated on the Susquehanna river, had apparently failed to appreciate some of its greatest advantages or to foresee the potential dangers in its streams. It lies on the east bank of the river, twenty-five to thirty feet above low water. Paxton Creek comes westerly from the hills, turns south at the upper limit of the city and for some distance runs parallel to the river, which it joins at the lower end of town. For years these streams remained, from almost every point of view, a menace to the city.

The water supply, which was pumped direct from the river, was black with coal dirt and laden with disease. Frequent floods inundated certain sections of the city, and by eroding the banks, endangered the street along the river front. The current was too swift for pleasurable boating or swimming, and in dry seasons the water was too shallow for either. At every street intersection with the river and creek, a sewer discharged, the effluent from which was carried along the whole length of the city, so that in dry weather, living on, or even walking along, the banks was most unpleasant. Malaria was rampant. Residents in the vicinity dumped ashes, paper, and even garbage, over the banks.

Paxton Creek passes for two miles thru the city, above which for two miles more its course is in a mosquito breeding swamp. Its banks were periodically flooded, considerably damaging certain low sections of the town. In the dry season its flow was largely sewage, its banks were vile, and it was a locality to be shunned.

The Civic Club of Harrisburg, composed of its most public-spirited citizens, both men and women, gave much thought to the matter from the beginning. The interest of the whole community was aroused, and in 1902 a bond issue of $1,000,000 was authorized by the city. The services of a consulting engineer of international reputation and of a prominent landscape architect were engaged, and a plan was adopted covering the great improvements that have since been carried out.

The first work done was to build a large concrete sewer, three miles long, to take the sewage out of Paxton Creek and carry it to the river below the city. This sewer was constructed in 1903 at a cost of nearly $200,000.

PAXTON CREEK *when it was a neglected open drain thru the heart of Harrisburg; photograph taken in the summer of* 1913.

PAXTON CREEK *after it had been regulated, giving a concrete-lined channel designed to carry the low-water flow and also the flood flow, and to be self-cleansing under both conditions. The section shown is along the railroad, but there is evident opportunity for beautifying the adjoining ground and thus giving the transient traveler on the passing train a pleasant memory of the city.*

Then came a filtration plant to purify the water. This plant, which was built in 1904-5 on an island in the river, cost a little over $300,000; it removes all the coal dirt, and about 99.7 per cent. of the bacteria, so that Harrisburg now has an ample, pure and attractive water supply.

Next, a flood storage reservoir was built on Paxton Creek, submerging a portion of the swamp two miles long and about a thousand feet wide. To form this reservoir an earth dam eight hundred feet long and about twenty feet high, was built, at a cost approximating $100,000. The control of the floods permitted the reclamation of the rest of the swamp below the reservoir, and the whole area is now included in the nine hundred acres of city park. The reservoir is so large that it prevents floods in that part of the creek which passes thru the city below, by retaining the water and allowing it to flow down gradually when the flood has subsided.

The lake formed by this storage offers delightful recreation to the people of the city at all seasons; a municipal boathouse holds numerous row boats and canoes, which are in demand during the summer, while in winter the skating is often good and the ice kept in condition by the city.

A second bond issue in 1911 made possible further improvements. In 1912-13 a concrete sewer was constructed the whole length of the city along the river front, with which all the sewers in the cross streets, previously flowing into the river, were connected. This sewer empties into the river at the lower end of the city, at the same point as the Paxton Creek sewer, so that practically all the city sewage is now gathered at one point to facilitate its purification at a sewage disposal plant soon to be built. With the construction of this sewer, at a cost of $125,000, the foul smell from the river has disappeared and the beautiful residences along the shore are no longer deserted when summer comes.

The brush-lined, irregular, filth-covered channel of Paxton festered, has been excavated to an even grade and smooth lines and faced with concrete. It is now a smooth-flowing stream in a clean and attractive channel in which floods are unknown.

The last thing in the scheme of municipal improvement was the building of a concrete wall, ten feet high, in the form

THE SHORE OF THE SUSQUEHANNA RIVER *when all the attention it got was from the residents along the parallel street and the casual city official seeking their good opinion.*

THE REGULATED BANKS *of the Susquehanna River, with vertical or stepped concrete wall protecting the shore from flood wash and giving a basis on which to found a landscape treatment of the banks above, which will make of them a continuous park and boulevard.*

THE DAM ACROSS *the Susquehanna River, which converts two miles of river front into a beautiful summer lake resort.*

of steps, along the low-water river line, for two and a half miles, with a fourteen-foot concrete walk at the top level. The bank above has been carefully graded and planted with shrubs and vines. The construction of this permanent bank at a cost of about $200,000 is not only a needed protection to the river front, but is a much appreciated addition to its attractiveness. The walk is much used by pedestrians and from it one gets an unobstructed view of the sun setting across the mile-wide, island-dotted river, with its background of wooded hills. The steps are used in going to and from row-boats and canoes.

A 4½-foot dam, three-fourths of a mile long, across the river, at the lower end of the city is now being built. This will give correspondingly deep and slack water along the river front for over two miles. Canoes have multiplied many fold in prospect of the early completion of this dam, which will eliminate the swift current and danger from rocks and shallows. Bath-houses will soon be built, and thousands of people will be able to enjoy this great lake.

During all this time, the city was acquiring, by gift and purchase, the land between the river and the west side of the street paralleling the shore, and converting it into a beautiful park. The last stretch of three blocks is now being condemned and purchased and the houses will be removed. This will give complete municipal ownership of the entire three-miles of river front, all converted into parkway bordering the river boulevard.

The financial cost of this whole work, including sewers, filters, storage reservoir, improved creek channel and river wall, and including remodeling much of the street sewer system, a great concrete viaduct and other minor works, engineering and administration, has been about $20 per capita of the 75,000 population, and a little over $1 a year per capita to pay interest and sinking fund on bonds. But this does not include the value of the time and thought that have been given to the work by the people of Harrisburg, who may well be proud of the result. The administration of all these works has been in the hands of a board of public works, whose members have been men of large affairs, who have given their time to the city without financial reward.

Harrisburg has been transformed and today few cities in Pennsylvania, perhaps in the whole country, have a more attractive water side, or better sanitary conditions in general. Of course, this great work, the pride, not only of the city, but of the state, was not accomplished without a large expenditure of time and money and it was all done by the city itself, without state aid. A city once shunned in summer as a typhoid, malaria-ridden place, has become desirable for summer residence, an ideal city of homes. With its public golf course, a dozen or more public tennis courts, numerous public playgrounds and nearly 1,000 acres of parks, it keeps its citizens well and happy and attracts many from elsewhere. Furthermore, the increase in assessed value of city property has been so great as to permit carrying on all governmental activities and paying interest and sinking fund charges on these improvement bonds without increasing the city tax rate.

Connecting Electrical Circuits to Water Pipes

Contrary to the former teachings regarding the necessity of preventing the collection of electric currents by water pipes and the dangers of electrolysis where the currents leave the pipes are the conclusions reached in a paper before the Central States Water Works Association, by Burton McCollum and O. S. Peters. The paper gives the data and the theory upon which the conclusions are based, the latter being stated in brief as follows:

1. Many of the dangers which arise from electrical circuits may be eliminated by earthing these circuits.

2. Of the means of earthing electrical circuits water pipes are by far the most desirable.

3. There is no danger of electrolysis by such stray alternating currents as may result from earthing low voltage alternating current circuits.

4. Direct current circuits should be earthed at but one point, preferably at the station.

5. Where conditions permit two or more, ground connections should be made on each secondary system.

6. In case of any individual low voltage circuit in which a number of earth connections to pipes are made, the earthing should be confined to one pipe system. Measurements of the resistance of the pipe line between the farthest removed points of connection should be made to make certain there are no insulating joints in the part of the pipe line which may cause the electric circuit to carry heavy stray currents from railways.

7. In making either single or multiple earth connections to water systems, unless it is positively known that there are no insulating joints near by, the adequacy of the earth connection should be determined by measurement of its resistance. Earth connections should not be made to cement joint lines, or other lines in which there are many joints of high resistance.

8. Connection to pipe lines may be made by screwing a brass plug into the bell in the case of cast-iron pipes or by clamps or soldering to service pipes. Soldering is preferable to clamps where it is possible to do it.

9. Earth connections to service pipes should be made at the point where there is the least likelihood of the pipe being disconnected between the connection and the main. If the water meter comes between connection and main a jumper of the same size as the ground wire should be put around it.

10. Earth connections to gas pipes should be prohibited chiefly on account of the chance of explosions or fires, and also because the almost invariable presence of water pipes makes such connections unnecessary.

11. Because of the great advantage to the public and the slight disadvantage, if any, to the public service corporations resulting from earthing to water pipes, such earthing of secondary systems should be made compulsory.

SYSTEMATIC SNOW REMOVAL
IN NEW YORK CITY

The removal of snow is an occasional job which has never had the attention it deserved until a genius in organization was put in charge of the street cleaning department in New York. J. T. Fetherston, the Commissioner of Street Cleaning, has worked out his detail of organization from registration of the necessary extra employes and provision of notice when their services are required to their payment within a few hours after their work is done, so completely that it worked almost to perfection the first time trying. Street commissioners in the smaller cities now have a model to follow which covers the ground so completely that they can scarcely find a local condition which is not taken care of. Instead of being proud that they have helped the sun get the snow off a few hours earlier than it might, unaided, they are shown how to get the snow off almost as it falls and at less expense than by the old methods.

THE removal of snow from city streets is an emergency undertaking, which requires mainly a strong organization ready to take up the work at a moment's notice, and large enough to complete the work in the shortest possible time. That the expense of preparedness shall not be prohibitory, the standing organization must have as few men, animals, wagons and machines fitted only for snow removal as possible, and must be able to call for a maximum of assistance from other departments.

Fortunately, with full co-operation of departments, these requirements can be met. The additional machinery necessary can be limited to the snow plows, scrapers, unloaders and the like, which will not be excessive in cost nor will they deteriorate in storage if properly protected from the weather.

The street cleaning and street maintenance departments are temporarily put out of business by the snow-fall and all their men, animals and machinery are available for the snow removal work. Garbage and refuse collection is also greatly interfered with and may be stopped altogether for a day or two by exceptionally heavy snow-falls, so that the equipment of that department can also be used during the early stages of snow removal.

The principal requirement for prompt and effective work is therefore a thoro preliminary organization of the forces available, each group of men and machines being instructed in advance as to its duties and place of operation, and the foremen being specially instructed as to the methods of operation peculiar to snow removal as compared with their regular duties.

With superintendent or superintendents on hand who are experienced in snow handling and full arrangement made for extra hours, call to duty at any time of day or night and a continuing provision for extra help, which must, of course, be kept closely in view, the work of snow removal can begin promptly as soon as the snow-fall is heavy enough to handle and continue with the storm and after until traffic conditions are again normal or nearly so.

The Commissioner of Street Cleaning of New York City, J. T. Fetherston, has worked out a system practically along the lines laid down above and for the following descriptions of them we are indebted to various papers and reports by him and his department.

This is the problem:

A heavy snow-fall retards traffic, causes unknown losses, not only indirectly, thru wasted time, services and delayed deliveries of merchandise, but also thru direct accidents or injuries to animals, pedestrians, cars or vehicles. The fire risk increases with the severity of the snow storm and under abnormal weather conditions might even imperil the whole city. Public health is menaced thru delayed removal of dirt and filth-impregnated snow. Pavements are damaged by the concentration of traffic between snow banks.

During February and March, 1914, New York experienced the worst snow period in twenty years. Over thirty-eight inches of snow was deposited by nine successive storms and temperatures remained below the freezing point most of the time during the forty-four days, while snow was being removed from the streets. This work cost the city directly about two and one-half million dollars and resulted indirectly in inestimable losses to the community. No large fires occurred during the period when street traffic was blocked and this fortunate circumstance alone prevented a possible calamity.

The old method of removal was by carts to dumps on the docks with a few sewers in use. Further experience with sewers as dumpers for snow demonstrated that:

1. Under ordinary conditions, snow will melt in a sewer within 300 feet from the point where it is dumped.

2. The theoretical number of B. t. u. necessary to melt snow checks the actual tests in sewers.

3. Two cubic yards per minute was found to be the maximum rate at which it is possible to shovel snow into a 24-foot diameter sewer manhole.

4. There is much more heat in sewage than is necessary to melt within 300 feet all the snow that can possibly be dumped into manholes.

5. Syphon sewers carry suow away as well as others.

6. Many sewers exist in Manhattan Borough which have never been used for snow disposal but which are as able to carry snow away as those that have.

Melting snow by various proposed methods was estimated from data secured to cost at least 55.2 cents a cubic yard using steam; 45 cents using electricity, and 28½ to 51.8 cents per load with coke and naphtha, without fully considering the cost of keeping the vast plant necessary in continuously good condition for immediate operation, and the hauling of the thousands of tons of coal necessary to serve the boro of Manhattan, and hauling out the many tons of resulting ashes.

Plans for the fight against snow were based on certain assumptions as follows:

(1) That a sufficient force of emergency labor could be started at work, day or night, within four hours after a continuing snowfall began.

(2) That a rate of pay sufficient to attract labor and make the men anxious to work would be offered by the city.

(3) That the weather conditions would not be so extreme as to prevent men from working during the storm.

(4) That a sufficient amount of normal sewage was flowing in the bulk of the sewers to transport snow to the rivers and harbor.

(5) That the ordinary flow of sewage could be supplemented by water from hydrants where the normal flow was insufficient to transport the snow.

This program involved a survey to determine what sewers could be used, the location of the available manholes on them and the places where the sewer flow should be aided by hydrant streams to keep the snow moving; weather conditions past and probable, based on close study of the United States Weather Bureau records; registration of laborers who could be called upon for the extra work required and methods of notifying them; assignments of men to gangs with time and place of reporting for work; the organization of police and street cleaning department regular employes to deliver the notices promptly; the provision of enough pan scrapers, road scrapers, scoops, plows, picks, etc., of the department standards to keep the men available in continuous employment and to furnish them promptly at the required localities; rates of pay necessary, time and overtime being paid at regular rates, with a 50 per cent bonus to regular employes for completion of the work within fixed time limits, and 30 cents an hour for regular work with 10 cents additional for completion of work within specified time limits to emergency men; assignments of clerks, inspectors, checkers, etc., from other departments to the snow-fighting force with an increase of 50 per cent of their regular pay for such work, these provisions for extra pay being the most important of all the plans for securing men promptly and insuring good and rapid work; methods of securing co-operation of citizens with the department in the work.

The organization of the street force was in three divisions:

(1) The first line of attack comprised regular street cleaning employees, supplemented by emergency laborers. The unit of organization was based upon the sweeper as leader of a squad of emergency laborers, working under the direction of regular department officers.

(2) The first reserve consisted of regular department drivers with horses and carts, drafted for a night shift, to clear streets where the snow fighting force could not use the sweepers.

(3) The second reserve consisted of private trucks for day or night service, used as a supplementary force when the two regular forces were unable to cope with storm. This reserve force was covered by the registration of private vehicles to be assigned according to the requirements of the situation.

A summary of results obtained in 1914-15 by comparison with plans and previous records shows greatly increased speed of removal with reduced cost:

A. On truck capacity basis of removal:

Rate of removal per day increased 4.71 times and cost per cubic yard decreased 77.3 per cent compared with average results between 1907-1911.

Rate of removal per day doubled, compared with the best previous record (1914) and cost per cubic yard decreased 67 per cent compared with the lowest previous unit cost record (1908).

B. On area basis of removal (area streets surface multiplied by depth of snow), considering only the snow fighting force:

Rate of removal per day increased 3.35 times and cost per cubic yard decreased 80 per cent compared with average results between 1902-1907.

Rate of removal per day doubled and cost per cubic yard decreased 75 per cent compared with best season's unit cost record of 1906-1907.

The increased speed of removal and reduced unit cost should be credited to the new method of snow fighting, using sewers for disposal.

It was necessary to start working on three storms, with a combined fall of 22.4 inches, and the total cost of snow work for the winter was less than $523,892. If all snow in 1914-1915 had been handled by contractors' trucking forces alone, the season's work at the lowest previous contract rate ($0.367 per cubic yard in 1907-1908) would have cost $1,584,882. At the 1914-1915 trucking rate the cost would have amounted to $2,370,846.

Weather conditions after the snow storms, however, were favorable for dispersal by melting, and neither of the above amounts can be accepted as conclusive, yet a conservative estimate indicates that the new system saved the city at least half a million dollars.

The 1914-1915 snowfall was 2.9 inches less than the average, and the temperature was 1.6 degrees F. higher than the average for forty-six years preceding.

About 40,000 emergency laborers were registered for the snow fighting force in November and December. Notification cards were made out for the laborers and sorted according to police precincts. Cards were likewise prepared for all regular employees of the Street Cleaning Department, and for other city employes drafted for snow work. All cards were sent to the police stations in the precincts in which the men lived, and were sorted by patrolmen's posts for distribution when the Police Department was notified that snow work was to start.

The plan of calling the men to work was generally successful and the Police Department deserves credit for the rapid and effective work in calling out the snow-fighters.

The responsibility for starting snow fighting work involved the exercise of judgment in determining whether or not a snow storm warranted action costing approximately $50,000 per shift. There were forty-five separate storms, of which nineteen contained snow. Practically all of the snow storms were of an uncertain character, so that it was not possible to start snow fighting when the storm began. This condition resulted in some delay in beginning work on the three storms on which work was done, but was repaid by the fact that no mistakes were made in starting unnecessary work.

Of the three working storms the first began on February 1, and falling temperature and the formation of ice on the pavement continued until 6:35 P. M. of February 2, during which time 1.9 inches of sleet and 0.5 inches of snow accumulated on the ground. Word was sent out to call the snow fighting force at 12 M. on February 2, and one shift started, finishing work at 1 A. M. on February 3. On February 3 and 4 another snowfall amounting to 2 inches made the total depth on the ground 4.5 inches of snow, ice and sleet.

The second working storm began at 5.25 A. M. March 6, and continued until 10.02 A. M. of March 7, during which time 7.7 inches of snow fell. The call to work was sent out at 8 P. M. March 6, and two shifts of emergency laborers were employed.

The storm of April 3 was entirely unexpected and made a record as the greatest April snowfall in the history of the local Weather Bureau—10.2 inches. The call for automobile snow plows was sent out at 1 P. M. April 2 and the call for emergency laborers at 3 P. M. Three shifts of emergency laborers worked continuously from 3 P. M. until 10 P. M. of the succeeding day, which was Easter Sunday.

The time allowed for calling out, assigning and actually starting snow fighting work thru the boros of Manhattan, The Bronx and Brooklyn was four hours, and the results indicated that it was feasible to turn out all men who reported within the time limit set. For the storm of February 1, 12,518 emergency laborers were provided with badges, tickets and

equipment, and at work on the assigned areas within four hours. The storms of March 6 and April 3 occurred on Saturday, and it was not possible to get a full quota of emergency laborers to report for work, but in each instance about 9,000 men were actually at work on the various streets of the city within four hours after the call was sent to the Police Department.

About 86 per cent. of the snow fighting work was finished within fifteen hours after the storm ceased, but disposal of snow piles by sewering on side streets was continued by emergency laborers for sixteen days. The snow fighting force removed eight times the amount of snow for practically the same cost as the trucking force.

By the use of hydrant water to supplement the regular sewage flow, even small pipe sewers were used to some extent, and of the area cleaned about 62 per cent. was actually covered by sewers used as compared with the 37 per cent. of the preliminary estimate.

Weather conditions were favorable for the work, but the prompt removal of the snow gave little opportunity for thawing weather to help in that removal.

Altho 40,000 laborers registered at the beginning of the season, men enough to fill all the assignments could not be obtained at the times of the three storms when they were needed. The upper west side district was specially short of laborers.

Very few gangs completed their work in time to secure the bonuses.

The police call for the men was very satisfactory.

The pan scraper used by the emergency laborers was fairly successful when not used as a shovel. There was but little extra equipment, it being purchased mainly from the regular department appropriation.

Automobile plows for opening up unscheduled streets and streets where the contract required them were generally successful, the damage to practically all the twenty-six machines in the first storm of dense snow and sleet resulting in changes in the design of the plows so that they stood up well in the April storm under heavy working conditions.

Only thirteen squad leaders received the 50 per cent. bonus and only 117 emergency laborers received the bonus rate for the entire winter, tho 30 cents an hour secured a reasonable tho not wholly sufficient supply of labor. The 50 per cent. extra compensation to men assigned from other departments was shown not to be excessive. The checking and verification system worked well and no irregularities were discovered. Men were paid on the day succeeding the end of the storm, 20,000 men being paid in five hours after noon of April 5, fifteen hours after the last shift finished work. The maximum compensation paid was $1.49 an hour to finance department gang checkers and the minimum was 19 cents to the same class of employes.

As compared with the average of the next preceding six winters, the first winter under the new plan showed the following results:

Average number of storms in which work was done, 3.5, as compared with 3 in 1914-15.

Depth of snow in working storms, 24.1 average, as compared with 22.4.

Day's work required to remove the snow, 37.5, average (8 to 46), as compared with 16.

Cubic yards of snow removed, 2,148,584, average (496,047 to 5,180,825), as compared with 4,318,481 in 1914-15.

Total cost, $1,146,574 (53.3 cents per cubic yard) average, as compared with $523,892 (12.1 cents per cubic yard).

Average cubic yards of snow removed per day, 57,296, average of preceeding six years as compared with 269,905 in 1914-15.

Sewers greater than 12 inches in diameter can be used as snow dumps if hydrant water is used to help the sewage flow and the snow is removed while clean, i. e., during the progress of the storm, and before rubbish accumulates in the streets.

The regulations made by the Sewer Department, Charles E. Gregory, chief engineer, for the use of sewers for snow removal are as follows:

Rules and Regulations for Panning Snow Into the Sewer Manholes

1. No manhole shall be open except when being used for the disposal of snow. Before depositing any snow in a manhole, the sweeper must see that the sewage is flowing free from obstruction.

2. A note shall be made of the approximate depth of flow in the sewer before the depositing of snow is begun.

3. Hose streams may be used to increase the flow in the sewers, and at as many points as may be served by the quantity of hose in the department. Additional hose may be borrowed from fire houses.

4. Careful watch shall be kept of the sewer, so that it will not choke from too rapid panning of snow, which should be shoved into the sewers at a uniform and continuous rate. Should the flow of the sewer fail to carry the snow away freely, panning at that manhole will be discontinued until the manhole has been cleared and the flow of the sewer restored.

5. Whenever the flow of the sewer or the water from the hose streams, or both, do not freely carry away snow after the panning has been discontinued, the District Superintendent of Sewers shall be immediately notified through District Headquarters and the snow piled near the manhole.

6. All snow deposited in the sewer manhole shall be free from sticks, stones, ice, cans, ashes, garbage, or other materials which would injure or obstruct the sewer in any way.

7. Should a squad be working over a trunk sewer, where the whole squad may be employed to clear the area about the manhole, one man shall constantly guard the open manhole.

8. All directions given by the District Superintendent of Sewers shall be implicitly followed.

MOTOR TRUCKS *fitted with snow plows, cleared unscheduled streets and certain streets for which their use was contracted, successfully, when the plow was made strong enough.*

9. No corporation, private individual, contractor, or any city department shall be permitted to dump snow in any manhole unless permission has been granted by the Commissioner of Street Cleaning and approved by the Engineer-in-Charge of Sewers.

10. The city contractors or other corporations or individuals who have permits for dumping snow in the sewers shall not be interfered with.

Rules and Regulations for Dumping Snow Into Sewers

1. Sewers designated for the dumping of snow may be used in two ways:

First—By dumping loads of snow directly into any manhole which has been designated for "dumping."

Second—By dumping snow alongside and shoveling it in at a uniform rate into a manhole which has been designated for "shoveling."

2. Before permitting the use of any manhole for the dumping or shoveling of snow, it shall be examined for physical defects, and the depth and rate of flow. If the flow is obstructed or the manhole is defective in any way, dumping shall not be permitted until the District Superintendent of Sewers has been notified and his consent obtained.

3. Dumping shall never be permitted at manholes not included in the list furnished by the Department of Street Cleaning and approved by the Engineer-in-Charge of Sewers.

4. An open sewer manhole shall never be left unguarded.

5. Whenever a manhole cover is removed it shall be placed on the sidewalk from which the snow has been removed, where it can be readily found and replaced as soon as the dumping is discontinued.

6. All snow deposited in sewer manholes shall be free from sticks, stones, solid ice, cans, ashes, garbage, or other material which would injure or obstruct the sewer in any way.

7. Keep careful watch of the sewer and do not allow it to choke from the too rapid dumping of snow. When continuous dumping directly into the manhole chokes the sewers, such dumping shall be discontinued until the sewer has resumed its normal condition and is free from snow. The deposits of snow into the sewers may then be continued, but the trucks shall be required to dump their loads beside the manhole and the snow shall then be shoveled into the sewer at such a rate as not to cause further clogging of the sewer.

8. Wherever a manhole has been designated for use of "shoveling," all trucks shall dump their loads beside the manhole from which place the snow shall be shoveled into the sewer at a continuous uniform rate, so as not to choke or obstruct the sewer.

9. Whenever shoveling snow into a sewer obstructs the flow so that the snow is not quickly carried away, shoveling shall be discontinued until the snow already in the sewer shall be carried away and the normal flow of the sewer has been resumed. Shoveling may then be resumed but at a slower rate, so as not to again obstruct the sewer.

10. Wherever the dumping or shoveling of snow repeatedly obstructs the sewer, the District Superintendent of Sewers shall be notified and he shall decide whether the use of such sewer or manhole shall be discontinued. All directions given by the District Superintendent of Sewers shall be implicitly followed, and then reported to the District Superintendent of Snow Removal.

The use of the sewers for snow removal did not materially increase the deposit in the sewer even though some of the snow dumped contained considerable dirt, ashes and garbage. There was evidence, however, of considerable physical damage to all sewer structures where compacted frozen snow was dumped in large quantities. It is believed, however, that the gain both in direct reduction of cost to the city for snow removal and to the public in the more rapid clearing of the streets far outweighs the expense of repairing the damage to the sewers.

The principal difficulties in handling snow in sewers, making the regulations necessary are:

The irregularity in flow of water, a cold snow finding the sewers with a minimum of flow, whereas a wet snow melting and running away in part as it falls, adds a quantity of water to the sewage which will carry away snow as rapidly as it can be dumped into the manholes.

Too rapid dumping of snow into sewers with small flow with the use of hydrant water to help carry it away may result in filling such sewers, usually small in size, with slush which produces stoppage and backing up of the water and sewage.

Heavy articles and large articles dumped with the snow produce stoppages, but dirty snow, even if very dirty, can be taken care of if not so accompanied, the floating snow and ice producing a scouring effect which carries ordinary sediment along.

The snow-fighting gangs are ignorant and pack manholes tight with snow. This does not interfere with the flow in the sewer, which breaks thru the snow below, but it takes the snow in the manhole a long time to melt out, so that the men must be trained not to dump the snow faster than it is carried away below.

The value to the city of the snow removal by sewers is so great that the sewer department will increase the minimum size of sewers and otherwise provide for their use for this purpose.

WATER SOFTENING BY FILTRATION

Dr. Robert Gans of the Royal Prussian Geological Institute has developed a synthetic hydrous aluminum silicate in combination with sodium which, when used as a filtration medium for hard water, exchanges its calcium and magnesium ions for the sodium ions in the silicate, transforming the filtration medium into a calcium silicate and the hardening salts in the water into sodium salts with the original acid radicals, thus reducing the hardness. The silicates, when saturated with lime and magnesia, are restored to the original sodium condition by forcing action in the opposite direction by means of a solution of common salt.

Robert N. Kinnaird, chief engineer of the Des Moines Water Company, has reported to the Iowa section of the American Water Works Association that he has been investigating a natural substance of the same nature by the use of which as a filtration medium he has been able to reduce a hardness of 300 parts per million to a reasonable minimum at a filtration rate of two gallons per minute per square foot of filter area.

Comparing the process with rapid filtration of water, Mr. Kinnaird estimates that the cost will not be materially greater than that of thoro filtration, except that the process of regeneration of the filter material will take longer than the ordinary washing of filters, and so a greater allowance for filters out of commission for regeneration must be made and therefore the original cost of the filter plant will be increased.

Dr. Edward Bartow of the Illinois State Water Survey has duplicated Mr. Kinnaird's results but apparently the process is not yet sufficiently developed to warrant full information regarding details of materials used or methods employed.

The Municipal Supply Department—I.

By Hugh M. Foster, New York City.

The purchasing agent is becoming almost as much the fashion in the municipal housekeeping force as the city manager, new agents being appointed almost every month. The city of New York has made the most detailed study of the duties of such a department, and the author of the articles of which this is the first on the principles underlying the New York system is examining inspector of purchase and supplies in the supplies department of the Bureau of Standards, under the Board of Estimate and Apportionment of Greater New York. He speaks with the authority of experience in the work and the plan he describes can be fitted to any conditions, reducing the amount of machinery and the number of employes to suit the smaller business of other cities.

THE list of cities which have recently established supply departments indicates a widespread interest in better and more economical service. These cities are Philadelphia, Baltimore, Washington, Atlanta, Pittsburg, Cincinnati, Cleveland, Dayton, Chicago, Memphis, Birmingham, Minneapolis, St. Paul, St. Louis, Cedar Rapids, Kansas City, Des Moines, Denver, Houston, Fort Worth, Huntington, Galveston, Los Angeles, Pasadena, Sacramento, San Francisco and Portland.

The justification for the purchase of supplies is the actual need therefor. Such needs should be recorded by accurate and ample statistics, and users of supplies should make their requests subject to the most severe scrutiny. To allow catalogs and other suggestive literature to get promiscuously into the hands of users of supplies only offers temptation for unnecessary requests. An office man who sees an illustration of a desirable electric fixture for his desk and immediately makes request on the electric department, simply wastes money. The waste of supplies is quite as apparent in such desires as it is in the throwing away of surplus. A garbage pail full of loaves of stale bread is an indication of the inefficiency of an institution; likewise, large cakes of ice standing on the sidewalk in summer.

The study of uses and the object to be accomplished should be carried on so as to maintain accurate knowledge at all times. The carpenter who orders clear white pine for making a clothes closet when No. 3 barn would do quite as well, is merely wasting the city's money. Requests have frequently been received for timbers as large as 10 by 10 of clear white pine, when yellow pine would have done just as well; and the clear white pine of that size costs about $125 a thousand, while the yellow pine costs $40. A good handbook on the uses and economics of lumber should be in the hands of every carpenter, and his requisitions should be made to comply strictly with the recommendations in such a book of instructions.

The natural temptation of the storekeeper and of users of supplies, even in small quantities, is to over-stock, and the antithesis of this in those who allow appropriations is to reduce to the condition of under-stock. Of the two evils, overstocking is the worse, because it happens more frequently and lasts longer. It should be noticed that the loss of interest on capital tied up in surplus stock is often a considerable item.

Waste of supplies after receipt is a large field for loss of money. This is especially apparent in the painting department.

The proper handling of requisitions in view of anticipation of needs and their conformity to standard specifications is the very corner stone of a good supply department. Requisitions should be made early enough before the actual time for the use of the supply, to permit the proper determination of quantity and quality to be ordered, to go thru the channels of local and general storekeeper to determine if the supply can be furnished from stock, and if not, to give the purchasing agent time to purchase to the best advantage of the city. Such time for the purchasing agent involves not only taking advantage of market fluctuations, but of assembling many requisitions for the same supply, so as to be able to buy in larger quantities and thereby obtain lower prices. All requisitions, no matter how small the quantities may be, should be written in strict conformity with the standard specifications. The purpose of standardization in supplies is for the uniformity of all articles used for the same particular need, to promote the use of one instead of many articles so as to buy in larger quantities and obtain better prices. These benefits are entirely obliterated if small, open market orders are written in lax or amateur phraseology, instead of strict, technical trade terms of standard specifications. It is folly to insist that large contracts shall conform to standard specifications and open market orders be exempt. Copies of all requisitions should be on file in the offices of the originator, the storekeeper and the purchasing agent, for the purpose of aiding investigation, leading to sound knowledge from all three points. Orders should, of course, follow the same method, not only for the purpose of affording knowledge of quantities and qualities previously used, but of informing the users of supplies and the storekeepers of the purchasing agents' methods, and where the supplies are to come from. By suggestion and criticism, the users of supplies and storekeepers effect a wholesome check upon the purchasing agent. The form for requisitions should be standard thruout all departments, and should in all cases give the following information:

Number.
Fund.
Charge Account.
Date.
User of Supplies.
Quantity.
Unit.
Articles (including full technical trade description).
Serial Number.
Standard Specification Applicable Thereto.
Quantities on Hand and Due.
Periodic Consumption.
Purpose of Use.
Approximate Value.
Order Number.

This information should be given for each and every item of supplies. Certification should be made as to the sufficiency of funds, and a certification from the proper official that the supplies requested are necessary.

Stores—Upon the proper administration of stores, from

the largest general storehouse of the city to the smallest stock of tools or supplies carried by the humblest workman, rests the success or failure of the supply department. The workman who carries one unnecessary or unsuitable article is as guilty of mismanagement, tho to so slight a degree, as the general storekeeper of a great storehouse for the entire city who carries unusable or surplus or old stock, or obsolete or scrap material. The object of the store, no matter how large or how small, is to supply the actual current need, and that only. Too strict a regulation and investigation of the method of stores cannot be installed.

Distribution—For the purpose of controlling distribution of supplies to the actual consumers, the fullest records of receipts and issues should be maintained. The purchasing agent and the storekeeper of a well organized supply department should have ample statistics to inform him at all times upon every item of supplies—how much for a given period each consumer uses. By constant investigation and inspection, these uses made by the consumers of supplies should be checked to determine that the supplies are really used and not wasted nor standing idly in stock.

Purchase, Bids, Orders, Contracts, Continuing Agreements, Specifications—While it is the natural desire of a storekeeper to get as much as possible of the best quality to supply the needs of those dependent upon him, it is the function of the purchasing agent to buy as little as possible and of the lowest quality and price to meet these requirements. By this condition of apparent opposition the one official acts as a beneficial check upon the other.

In the promulgation of bids, orders, contracts and continuing agreements, a strict, orderly procedure should be maintained, which will, at all times, encourage competition and obtain the best supplies needed at the lowest prices obtainable.

Searches for new sources of supplies should constantly be undertaken to bring in new blood, as it were, and to stimulate competition. The consummation of a contract for supplies requires the following procedure:

The preparation of contract requirements in items, quantities, etc.

The approval of specifications.

The approval of the whole contract by the legal officer of the city.

The approval of the financial aspect by the fiscal officer.

Advertising for bids.

The awarding of the contract.

The ordering of deliveries and the forwarding of copies of such orders to the general fiscal officer.

The receipt of the supplies, acceptance and storing.

Inspection.

Laboratory tests.

Checking bills and assembling and forwarding copies with orders to the general fiscal officer.

The preparation and signing of vouchers.

The audit of bills and orders by the department receiving the supplies.

The forwarding of the bills and orders to the general fiscal officer.

The audit of the same by him.

The preparation of the same by him.

The preparation of warrants by the fiscal officer.

The recording of vouchers in his records.

The signature of the fiscal officer, the treasurer and the mayor.

The payment of the claim.

This elaborate procedure applies, with varying modifications, to bids, orders, contracts and continuing agreements. That is, bids must be made in conformity with the procedure and forms prescribed by the auditing department. Open market orders should fulfill all the general requirements of a large contract, except the legal provisions. From the beginning to the end of the transaction of purchase, standard specifications should be adhered to. The bids or requests for bids by the purchasing agent on prospective dealers, and the orders for purchase, and the orders for delivery on contract, and the orders against a continuing agreement, should all be standard in form thruout all departments, and should give, in detail, the following information:

Number.
Date.
Requisition Number.
Fund.
Charge Account.
Dealer to Whom Order is Issued.
Point of Delivery.
The Item.
The Quantity.
The Unit.
The Article (giving full technical trade description).
Serial Number of Standard Specification.
Unit Price.
What terms of payment.
Certifications of the Necessity of Supplies and of Sufficiency of Funds.
Certification of receipt.

Delivery and Inspection—When all departments of the municipal government buy and receive supplies separately, that condition defeats economy in purchase, and quite as strongly militates against efficiency in inspection. Thruout the greater city of New York there are, at present, over 2,100 delivery points for supplies. It is obvious that such diffusion prevents anything like complete inspection of all supplies delivered. Inspection that is not complete in the sense of covering all places where supplies are delivered and all the supplies delivered at each place, merely offers the opportunity for an unscrupulous contractor to learn the place where and the supplies by which he can most easily evade inspection. The establishment of a general and central storehouse with the minimum of branch storehouses would concentrate deliveries and intensify inspection. An enormous monetary economy may be achieved by the concentration of deliveries. A contractor who is required to send out a truck and team for a few pails of white lead is under necessarily heavy expense, and must cover that expense by his price. If such supplies are delivered only in annual or semi-annual deliveries, the unit cost of trucking is enormously reduced and the city gets the benefit.

A complete system of records of inspection with appropriate certifications as to the time, place and name of the inspector passing the supplies should be maintained. The storekeeper and his subordinates at various institutions or branch storehouses, and the final recipient or consumer of the supplies, all act as a wholesome check upon inspections and will be quick to find fault with improper inspection. The officials should be in ready touch with the purchasing agent, and the auditor or the comptroller, to notify these higher officials of any laxity of inspections, and a prompt investigation should be made upon such reports. All deliveries should be accompanied by invoices or memoranda bills in quadruplicate. One copy should go to the final recipient, one to the general storekeeper, one to the auditor of the department concerned and one to the division of inspection. Such a method gives opportunity for settlement of dispute as to quantities at once without needless delays, which allow the contractor to blame the receiver of the supplies for shortages. Delivery slips, which are merely memoranda of delivery without prices, as in an invoice, should follow the same procedure.

A complete system of tracing deliveries should be maintained by the storekeeper, and he should daily report to the

purchasing agent all delinquencies. Dealers who are negligent in this respect should be discountenanced.

Obsolete and Scrap Material—Thruout the city all departments and sub-divisions of departments should forward to the general storehouse surplus, obsolete and scrap supplies. A monthly investigation of these items should be undertaken at all institutions and branch stores, and such regularly sent forward to the general storehouse for assembling there. By the rigidity with which this work is done, the city avails itself of selling such supplies at public auction in greater quantities, and therefore obtaining better prices. The general storekeeper should receive daily reports from all institutions and branch storehouses of any superfluity on hand, so that upon receiving a requisition for a given supply from one institution or branch storehouse, if he has not the article in stock, may call upon some other institution or branch storehouse to furnish it. It frequently happens that one storehouse is in urgent need of an article, which has been collecting dust on the shelves of another institution for years. Such a condition is an inexcusable waste, by necessitating the purchase of that article for the institution in need instead of its being supplied by the institution which has the surplus.

Consumption—The consumption of supplies in city institutions is generally in a chaotic condition, because accurate and complete statistics are not kept of quantities, reasons and results. By the proper records an accurate quantity of every article of supplies should be established for every purpose. Such a method has been undertaken to considerable extent thruout public institutions of the country in relation to food supplies, but the same method can be made to apply to clothing, paints, lumber, hardware, coal, forage and other large items. Such regulations should be established on precisely the same system as are rations for an army, and while it requires time and labor to institute such a system, when it is once established, it will be much simpler to maintain and will insure economical current use.

IMPORTS OF CREOSOTE OIL

The war-time history of foreign creosote oils as sketched by G. A. Lembcke for the American Wood Preservers' Association shows that the situation has been relieved somewhat.

During the months immediately following upon the outbreak of the European war it looked as if all shipments of creosote oil from Europe were definntely and suddenly stopped. The British, as well as German governments, immediately placed an embargo on the exportation of creosote oil on the grounds that they needed it for their own purposes. In Germany, the embargo still exists, while in Great Britain it was found that the fact that the British creosote oil solidifies unless kept at a temperature of about 90 degrees F. made its employment for the purposes originally intended impossible, and the embargo against exportation was consequently withdrawn. Even then, as the British Admiralty had commandeered for their own purposes practically all available tank steamers, the question of transportation from the United Kingdom to the United States offered serious difficulties.

As time went on, however, it was found that the tar distillers in Great Britain were called upon by the government to make deliveries of coal-tar products for the purpose of manufacturing war material. Incidental to supplying this demand, increased quantities of creosote oil were produced and subsequently accumulated in the available storage tanks of the distillers. Thus gradually a situation arose where the distillers' creosote storage needed relief in order to enable them to meet the government's demands for coal-tar products for ammunition manufacture. Confronted with this situation the British Admiralty finally consented to relieve the storage by releasing from time to time, as needed, tank steamers for the purpose of conveying from the accumulated stocks creosote oil from the United Kingdom to the United States. The result of this action was that during the second half of 1915 shipments to this country were made in larger volume than during the early part of the year.

While under present conditions, on account of the censorship and other precautionary regulations in Great Britain, it is more difficult to secure exact records and figures, from the information available and at hand it can be estimated that the shipments of creosote oil from the United Kingdom to this country during the year 1915 amounted to about 30,000,000 to 35,000,000 United States gallons. Compared with importations of foreign creosote oils during 1912 of approximately 60,000,000 United States gallons; during 1613 of approximately 55,000,000 United States gallons, and during 1914 of approximately 43,000,000 United States gallons, the above importations naturally show a considerable decrease.

It must be considered, however, that this year's total imports excludes all German and Belgian oils, and that the total volume of importations for 1915 consisted of British creosote oil only. Due to the fact that several of the large railroad systems on account of uncertainty of supplies, decided to abstain for the time being from the use of creosote oil, as well as to the depressed general conditions in this country, particularly during the early part of 1915, the importations during 1915 sufficed to meet in a measure the somewhat decreased demand.

How the position is going to shape itself during the year 1916, or even beyond that, of course, remains to be seen and is largely dependent on the duration of the war. If the war should be protracted for another year German and Belgian supplies will not be available for importation. The loss, however, will in all probability be slightly offset by an increased quantity of creosote oil available for shipment in the United Kingdom where as a result of the increased demand for coal-tar products a good many byproduct ovens have replaced the old beehive ovens. It must, however, not be assumed that such possible increase in the production of Great Britain be sufficiently large to totally offset the loss caused by the falling off in Continental quantities.

The law of supply and demand suggests that prices for foreign creosote oil in this country will remain about on the present level as long as conditions are as just outlined. Even should the war end some time during 1916 it is not reasonable to suppose that a decided change in price will take place.

Stocks in Germany are entirely exhausted, and export of creosote oil after the war must of necessity at first at least be slow and reduced in volume. In Great Britain and the other countries involved in this war an immense amount of renewal work must be done after peace is declared, and, therefore, European consumption will be increased while the total output of creosote oil probably will assume ante bellum proportions.

Water Tower for High-Pressure System

OF BOSTON, MASS.

To supply pressure for some of the higher districts of Boston the small tower shown in the above cut has been in use for some years. Greater capacity being required now, the larger tower has been constructed of steel surrounded by a masonry wall for protection from cold and weather.

THE Metropolitan Water and Sewerage Commission, Boston, Mass., has had constructed a circular water tower on the summit of Mt. Bellevue, in the West Roxbury district. The elevation of the top of this hill is 340 feet, it being the highest point in the city. The reservoir provides extra high pressure service to the southern portion of the Metropolitan District, including West Roxbury and Hyde Park.

The tower, which has a capacity of 2,500,000 gallons, consists of a steel plate tank enclosed in granite masonry, with a roof. It is circular, 114 feet 2 inches in outside diameter. The tank is 44 feet high and 100 feet in diameter and rests on a concrete foundation and floor having a minimum thickness of 12 inches. There are seven courses of steel plates, the bottom course being $\frac{7}{8}$ inch thick, diminishing to $\frac{3}{8}$ inch at the top course. The plates are in 20-foot sections, 6 feet 4 inches wide, and are boiler riveted. The steel plate floor of the tank is supported on the concrete base, with mortar joints, poured thru holes in the floor, intervening.

The masonry walls are 47 feet in height and stand on concrete foundations, which extend 8 feet below the general ground level. The face of the wall is of squared stone masonry, with no projections or depressions of more than two inches from neat line of wall. No stones have less than a 6-inch rise nor 12-inch length of bed. Stretchers are at least 12 inches deep, and headers 20 inches.

The face of the base of the tower below the water table is coursed granite. The face of the water table, the voussoirs

THE OLD TOWER ON THE RIGHT, THE NEW TOWER ON THE LEFT.

of the arch at the front entrance, the bands above and below the upper windows, all window sills, the upper course of the cornice and the exposed surface of the parapet coping are rough pointed. Other trim surfaces are fine pointed. Rockport granite was used, being brought to Boston by schooner and hauled to the site. A wire cable operated on a drum by a portable engine also operating derricks, was used to assist the wagons up the steep incline. All stone except for trim was shaped on the ground.

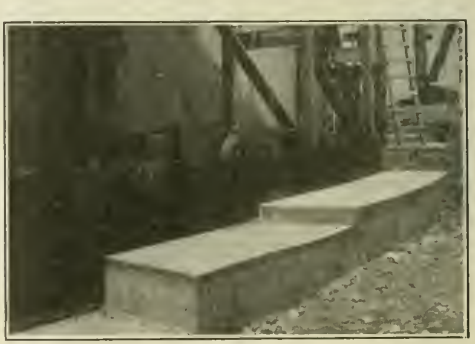
Between the masonry and the tank is a concrete backing with a maximum thickness of 14 inches, and between this and the tank a space four feet wide. The concrete consists of a 1:2:4 mix, with Plum Island sand and broken stone. Mortar used for joints was one part cement to three parts sand. The specifications provided that no stone masonry be laid more than three feet in advance of the concrete backing, and that the walls be kept at a fairly uniform height around the circumference. Water-tight forms were used.

Steel work, pipes, anchor bolts, etc., are built into the concrete, a layer of mortar being placed next the materials and finer portions of the concrete deposited next the mortar.

Walks around the bottom of the steel tank, and concrete

GROUTING FOUNDATION *of steel bottom of tank. The process of pouring the grout into the various funnels shown is clearly seen. The foundation is thus made homogeneous, so that unequal strains are not put on the steel. The holes for the grouting pipes are afterwards carefully capped.*

CONCRETE FOUNDATION *for the masonry tower surrounding the steel tank seen in the background.*



stairs leading up inside, have a one-inch granolithic surface of 1:1 mix.

A parapet 4 feet high above the cornice runs around the roof, which is pyramidal in form, with a central hexagonal roof. An observation tower is provided.

The steel roof trusses are supported on six steel columns, set 17 feet inside the wall of the tank. The turret roof is covered with Imperial German interlocking roof tiles, and the remainder of the roof is of reinforced concrete covered with a layer of reinforced Neufchatel asphalt. The turret walls are of Natco XXX 4x12-inches hollow terra cotta tiles laid in cement and plastered with cement on the outside face. The roof tiles, which are a full-glazed dull green, 16x9 inches, are laid with an 8x13⅜-inch exposure, directly upon steel angles, and fastened with copper clips.

Iron stairways lead from the front entrance up to the roof, and from the front entrance down to a granolithic wall constructed around the enclosed steel tank.

The total cost of the work was $71,271, divided as follows: Foundation and grading, $5,874; steel work, $19,397, and masonry, $46,000. The contractors for these three divisions were John E. Palmer, Boston; Walsh's Holyoke Steam Boiler Works, Holyoke, Mass., and John Cashman & Sons Co., Quincy, Mass. W. E. Foss is the Commission's acting Chief Engineer, in whose charge the tower was constructed.

LAYING COURSED ASHLAR *in the masonry wall surrounding the steel tank. Note space between masonry and steel.*

THE HIGHEST DAM IN THE WORLD

The Arrowrock Dam near Boise, Idaho, which has recently been put in service stores water for irrigating the Boise Project of the United States Reclamation Service in the neighborhood of such cities as Boise, Nampa and Caldwell. It is the highest dam in the world, having a height of 348.5 feet. It is 1,100 feet long on top, has a 16-foot roadway on its crest and contains 585,200 cubic yards of concrete. It has a gravity section and in plan shows a curve of 680-foot radius. The spillway is 400 feet long with a concrete-lined discharge trench approximately 900 feet in length with a capacity of 40,000 second-feet. In the spillway and trench lining are 25,400 cubic yards of reinforced concrete.

This spillway has a movable crest which may increase the storage of water six feet above the fixed crest, but drops automatically, very slowly, in case of flood, so as to give the full capacity of the spillway when needed. It rises automatically again when the flood has passed.

Logs floated down the river by lumbermen are hoisted to the top of the dam by a cable lift and taken to the river below thru a reinforced concrete chute 650 feet long, the upper 400 feet of which carries a bull chain with spurs or teeth set to hold against sliding, which carries the logs down a 62½ per cent slope and delivers them to a gravity chute thru which they pass to the river. It is estimated that there is three billion feet of timber in the Boise Basin above the dam that must be handled in this way.

A standard gage railroad, 17 miles long from the Oregon Short Line, was required and in four years has carried 80,000 passengers and about 14,000,000 ton-miles of freight. It is the only railroad in the country operated by the Federal Government and all tickets carry the signature of President Woodrow Wilson in facsimile.

A 3,000 horse-power hydro-electric power plant was built to furnish power for the operation of the construction plant, whose plus output has been sold to local companies. A sawmill was operated for almost two years in the forest above, furnishing 6,750,000 feet of lumber for the building of the construction camp at Arrowrock, and supply timber for trams and miscellaneous requirements on the work.

The excavation for the dam extended 90 feet below the river bed to the granite foundation, and a diversion tunnel 500 feet long with a cross section 30x25 feet carried the river around the work until the construction was far enough advanced to start the storage of water.

Regulating outlets in the dam are 20 in number each being 4 ft. 4 in. in diameter, and controlled by a 58-inch balanced needle valve on the upstream face of the dam. They are arranged in two sets of 10 each, the upper set being 150 feet above the river bed. Five sluicing outlets, each controlled by a 5x5-ft. sliding gate, are also provided at river level. All these outlets are operated from control chambers inside the dam.

A system of inspection galleries of which the control chambers are a part give access to the dam at several elevations, the lowest of which is 230 feet below normal high water surface in the reservoir. The capacity of the reservoir is 244,300 acre-feet, or about 79,600,000,000 gallons. The reservoir is 18 miles long and extends up two forks of the river. When needed for irrigation the water is carried down 12 miles in the channel of the river to a low diversion dam and from there taken out over the land thru a network of canals and laterals. In this way 234,000 acres of sagebrush desert is to be converted into gardens, orchards and farms.

The principal quantities involved in the construction of Arrowrock dam and the spillways are as follows: Excavation, 682,000 cubic yards; concrete, 610,600 cubic yards; reinforcing steel, 1,350,000 pounds; gates and structural steel, 1,800 tons.

BOOKS ON PURIFICATION OF WATER

Many readers having asked for a revision and extension of the classified descriptive lists of books on municipal engineering subjects which were printed in MUNICIPAL ENGINEERING *some years ago, this list of books on water purification has been prepared as the first of a series of lists which will follow at intervals as they may be asked for. Any desired books will be included in these lists on request and if any have been omitted the omissions will be supplied on notification. The list has been confined almost wholly to books in the editor's library.*

BOOKS treating of the purification of water may be divided into four general classes: (1) Those which treat generally of the desirability or necessity of water purification and give more or less idea of the methods in use; (2) those describing methods of purification in use; (3) those giving methods of examination and analysis to determine the necessity of purification and amount required, and to determine the results of purification processes; (4) books on water supply which devote one or more chapters to the subject of water purification.

(1.) In the first class the following books are at hand:

Water Supply, Chemical and Sanitary, by William R. Nichols, was the earliest book on the subject and is still one of the best, but is now out of print.

Clean Water and How to Get It, by Allen Hazen, gives a good general view of the methods of obtaining good water from selection of a good supply to purification of one not so good, and an excellent comparison of various methods of purifying water. Cloth, 196 pp., $1.50. John Wiley & Sons, New York.

The Purification of Public Water Supplies, by John W. Hill, C. E., begins with a study of typhoid fever statistics and typhoid and other bacilli and continues with descriptions of processes of filtration, filter plants in operation and proposed, with figures of cost and a discussion of the legal liability for damage from sewage polluted water, which is perhaps somewhat extreme in some of its views in the light of present practice. A new edition brings it up to date. Cloth, 304 pp., $3. D. Van Nostrand Co., New York.

Water Supply Considered Principally from a Sanitary Standpoint, by Prof. W. P. Mason, is one of the earliest books on the necessity for water purification which has been kept up to date by new, rewritten editions from time to time. Cloth, 167 pp., $1.25. John Wiley & Sons, New York.

The Value of Pure Water, by Geo. C. Whipple. Cloth, 407 pp., $3. John Wiley & Sons, New York.

Municipal Chemistry, edited by Charles Baskerville, has two or three chapters on purity and purification of water. Cloth, 526 pp., $5. McGraw-Hill Book Co., New York.

Water Supply, an English students hand-book on the conditions governing the selection of service and the distribution of water, by R. E. Middleton. Cloth, 178 pp., $3. J. B. Lippincott & Co., Philadelphia, Pa.

Water and Its Purification, by Samuel Ridcal, is an English book covering much the same ground as Hazen's, mentioned above, somewhat more in detail and applying more particularly to English conditions, but an excellent book for use anywhere. Cloth, 346 pp., $3. J. B. Lippincott & Co., Philadelphia, Pa.

2. In the second class are the following:

Filtration of Public Water Supplies, by Allen Hazen, was among the first books giving full detail of practice in treatment of water and in its latest edition is one of the best. It goes into detail of construction, operation and results of continuous, intermittent, mechanical and other filters, coagulation and other chemical treatments, cleaning filters, etc. Cloth, 321 pp., $3. John Wiley & Sons, New York.

Water Filtration Works, by James H. Fuertes, is a book on the design of water purification plants, including intakes, settling basins, slow sand filtration beds, rapid sand filtration apparatus, both gravity and pressure, small individual filters and filtered water reservoirs. Cloth, 283 pp., $3.50. John Wiley & Sons. May be out of print.

Water Purification Plants and Their Operation, by Milton F. Stein, assistant engineer of design on Cleveland filtration plant, is a manual for operation of water purification plants and the latest book on the subject. It is devoted principally to slow sand filtration plants and the larger installations of mechanical filters. It goes into detail on methods of operation of the plants, and gives full instructions for making physical, chemical and bacterial tests, and the interpretations of the results. It also describes the theory and practice of coagulation, sterilization with hypochlorites, chlorine, etc., water softening and sedimentation and gives the detail of the operation of the filters, records, statistics, cost, etc. For the class of filters covered it is the most practical book which has appeared. Cloth, 247 pp., $2.50. John Wiley & Sons, New York.

Water Purification and Sewage Disposal, by Dr. J. Tillmans, is a German book translated by Hugh S. Taylor, about half of which gives a clear but brief statement of filtration and sterilization of water for domestic purposes, and purification for industrial uses. Much is included in very brief compass. Cloth, 143 pp., $2. D. Van Nostrand Co., New York.

Purification of Sewage and Water, by W. J. Dibdin, is an English book, about 75 pages of which is on the subject of sand filtration of water. Cloth, 380 pp., $6.50. D. Van Nostrand Company, New York.

Water and Sewage Purification in Ohio; is a report of the State Board of Health, made in 1908, which gives descriptions of plants in operation in the state and statements of results of operation.

Water Purification at Louisville, Ky., by George W. Fuller; is a report of the experiments on water filtration made by that city in 1895 to 1898 and of the conclusions reached. Cloth, 460 large pages with numerous diagrams, $10. D. Van Nostrand Co., New York.

Other books listed in catalogs are Wehrenfenning & Patterson's "Analysis and Softening of Boiler Feed-Water," 290 pp., $4; Rector's "Underground Waters for Commercial Purposes," 97 pp., $1.

3. In the third class are the following:

Examination of Water, chemical and bacteriological, by Professor William P. Mason, is quite full upon the chemical examination of water, and rather brief as to bacterial methods, as such methods were not very fully developed at the date of issue. Cloth, 135 pp., $1.25. John Wiley & Sons, New York.

The Microscopical Examination of Potable Water, by Geo. W. Rafter, gives the technique of examinations of plankton and tables of results of the same. Boards, 160 pp., 50 cents. D. Van Nostrand Co., New York.

The Microscopy of Drinking Water, by George C. Whipple, gives not only methods of analysis, but a full description of the organisms found, their geographical, seasonal, horizontal and vertical distribution, the odors and tastes produced, the consequences of storage of surface and ground waters, growth of organisms in water pipes, and a detailed classification and description of the species of plant and animal life under discussion. Cloth, 300 pp. and many plates, $3.50. John Wiley & Sons, New York.

Elements of Water Bacteriology, with special reference to sanitary water analysis, by S. C. Prescott and C. E. A. Winslow, is a full discussion particularly of bacillus coli communis and accompanying forms, methods of isolating and counting, and interpretation of results and is an excellent text-book on this subject. Cloth, 318 pp., $1.75. John Wiley & Sons, New York.

Water Analysis for sanitary and technical purposes, by Herbert B. Stocks, is an English hand book of the chemical examination of water with formulae for reagents and descriptions of the various processes. Cloth, 136 pp., $1.50. J. B. Lippincott Co., Philadelphia, Pa.

Chloride of Lime in Sanitation, by Albert H. Hooker, has one chapter on its use for water purification. Cloth, 230 pp., $3. John Wiley & Sons, New York.

Laboratory Notes on Industrial Water Analysis, by Ellen H. Richards. Cloth, 56 pp., 50 cents. John Wiley & Sons, New York.

Air, Water and Food from a sanitary standpoint, by Ellen H. Richards and A. G. Woodman. Cloth, 278 pp., $2. John Wiley & Sons, New York.

4. In the fourth class the following may be mentioned among those published:

Public Water Supplies, requirements, resources, and the construction of works, by F. E. Turneaure and H. L. Russell. This complete discussion of water supply problems devotes about 200 pages to the quality of water supplies and works for the purification of water, including sedimentation with and without coagulation, slow and rapid sand filtration and other forms of purification, including softening and the use of chemicals, giving a very satisfactory amount of detail as to design and results. Cloth, 808 pp., $5. John Wiley & Sons, New York.

Water-Supply Engineering, by A. Prescott Folwell, devotes a few pages to an excellent brief description of modern methods of water purification. Cloth, 570 pp., $3.50. John Wiley & Sons, New York.

Elements of Sanitary Engineering, by Mansfield Merriman, has a chapter on water and its purification and descriptions of plants in appendices. Cloth, 250 pp., $2. John Wiley & Sons, New York.

Water Works for Small Cities and Towns, by John Goodell, has a brief 14-page chapter on filtration plants for such works, showing the limitations for such service. Cloth, 286 pp., $2. McGraw-Hill Book Co., New York.

Sanitary Engineering with respect to water supply and sewage disposal, by L. F. Vernon-Harcourt, is an English book with a good 40-page chapter on purification of water by sedimentation, filtration, aeration, and softening, with examples from English and colonial practice. Cloth, 419 pp., $4.50. Longmans, Green & Co., New York.

Water and Water Supplies, by Dr. John C. Thresh, is an English book of 527 pp., 300 of which are on the purity of water and how to secure it. The discusion is more from the sanitary point of view and less from those of design and construction than most of the others mentioned. $2. P. Blakiston's Son & Co., Philadelphia, Pa.

Water Supplies, their purification, filtration, and sterilization, by Samuel Rideal and E. K. Rideal, is a book by one of the foremost English experts in water and sewage purification which goes into detail in all the lines mentioned in its sub-title. As it is but a year old it is quite up to date, and gives greater detail about the application of the most recent improvements in methods of purification and especially sterilization, than any of the books in this list except, possibly, Stein's. Cloth, 274 pp. D. Appleton & Co., New York.

Books reported in press by Van Nostrand's latest catalog, which give attention to water purification, are Corey's "Water-Supply Engineering" and Hill's "Interpretation of Water Analysis."

THE CITY MANAGER PLAN FAVORED

The committee of the National Municipal League on municipal program heartily approves the commission-city management plan as the ideal way in which to run a city.

The committee has recommended that the city manager shall be the chief executive officer of the city, that he shall be chosen by the council or commission solely on the basis of his executive and administrative qualifications, and the choice is not limited to inhabitants of the city or State. The committee suggests that he shall be appointed for an indefinite period and removal by the council, but if removed after six months he may demand written charges and a public hearing before the council prior to the date on which his final removal shall take effect.

The city manager under the plan is made responsible to the council for the proper administration of all affairs of the city and to that end shall make all appointments, subject, of course to proper civil service provisions which are made a part of the model charter. Except when the council is considering his removal, the city manager is entitled to be present at all the meetings of the council and its committees and to take part in their discussion.

A council elected at large is provided for cities of average size, but in cities of more than 100,000 population, the city should, in the opinion of the committee, be divided into large districts, the size of which should never exceed 50,000 except in cities over a million. The purpose of this limitation is to keep the size of the district down to such a point that genuinely free competition for public office will prevail, the expense of a thoro canvass being not too great for an independent candidate who may lack the support of a permanent political machine.

The model charter contains up-to-date civil service, financial franchise provisions, as well as other necessary features of a charter.

The committee consists of William D. Foulke, of Richmond, Ind., chairman; M. N. Baker, of the Engineering News; Richard S. Childs, New York City; John A. Fairlie, University of Illinois; Mayo Fesler, Cleveland; A. R. Hatton, Western Reserve University, Cleveland; Herman G. James, Austin, Texas; President A. Lawrence Lowell, of Harvard; William B. Munroe, Harvard; Robert Treat Paine, Boston; Delos F. Wilcox, New York City, and Clinton Rogers Woodruff, Philadelphia.

QUESTION DEPARTMENT

Builders of Incinerators

We have a contract with this city that binds us to have a twenty-ton incinerator plant in operation here within six months.

We are informed that you probably could be of assistance in giving us the address of some firms who make a specialty of this sort of thing.

A., ———, Ill.

A lsit of builders of garbage disposal plants will be found in MUNICIPAL ENGINEERING, vol. xlvi, p. 381, and reference may also be made to the Business Directory published in each number of MUNICIPAL ENGINEERING, under the heading Garbage Disposal Plants.

Swimming Pools and Supplies for Them

Can you direct us where we can get information concerning the erection and cost of operating public swimming pools and where me can get supplies for them?

C., ———, Kan.

Several brief articles in MUNICIPAL ENGINEERING give descriptions of swimming pools, from a small street pool, serving also as a sewer flush tank, to the elaborate bath houses of New York and other large cities and the bathing beaches on artificial and natural lakes in or near inland cities.

The enclosed swimming pool at Rochester, N. Y., is illustrated on pp. 21 and 24 of vol. xxxix.

The open air swimming pool in Fuller Park, Chicago, is shown in vol. xliii, p. 401, the article giving also dimensions and equipment of various pools in the city and the methods of waterproofing them are described.

The cost of a pool in St. Louis, Mo., and the cost of operation, total and per capita, are given in vol. xlvi, p. 107, and vol. xlvii, p. 128, and a photograph of it in use will be found in vol xlviii, p. 354.

A large pool in McKeesport, Pa., is illustrated in vol. xlvii, p. 127.

Denver, Col., pools are described and illustrated in vol. xlvii (p. 128 and 312; vol. xlvii, p. 451, and vol. xlviii, p. 197.

One of the three outdoor pools in Toledo, O., is illustrated in vol. xlviii, p. 291.

A unique outdoor pool which serves in emptying as a sewer flush tank is shown in vol xlix, p. 212. It is at Oakdale, Cal.

An elaborate bathhouse for all year round use, with bathing facilities as well as swimming pool, and a gymnasium in Chelsea Park, New York City, is illustrated in vol. xlviii. There are many of similar nature in the largest cities.

Oklahoma City, Okla., Boston, New York, Chicago, have pools open the year round.

Many other cities, such as Cincinnati, Milwaukee, Indianapolis, Kansas City, Cleveland, have pools and bathing beaches which are not inclosed and can be used only in the summer season.

A general article on the value of public baths will be found in vol. xlvii, p. 403. A method of purifying water from swimming pools so that it can be used again and again, thus saving water bills in a city, and heating bills in the winter, is described in vol. xliii, p. 159.

The A. G. Spalding Co., Chicopee Falls, Mass., and New York City, supply anything needed in the operation of swimming pools and bath houses.

Preventing Growth of Algae in Water

What is the experience in combatting algae growths in water where the object is not potability but freedom from vegetable growth which clogs up screens? We have a steam power plant recently started in the South using a maximum of 20,000 gallons a minute of condensing water, where the algae grow so luxuriantly that they give us trouble in the screens of our intake.

S., ———, Pa.

Revolving screens, some automatic in their action, have been used in sewage purification work in Germany with success and would doubtless be applicable in such a case as this. The Uhlfelder revolving screen has five radial screens which rotate uniformly against the current of water, removing the coarser material and lifting it out of the water, when an automatic brush forces it outward onto a platform which in turn is tipped up by the motion of the screens and emptied on a traveling platform which carries it away. The Riensch-Wurl screen recently introduced into this country by the Sanitation Company of Philadelphia may also be applicable if its operation is not too expensive. Probably either of these automatic screens would operate at less expense under the conditions described in the question than a bar or fine screen cleaned by hand, even tho the algae require attention for only a comparatively short part of the year. A brief description of the Uhlfelder screen will be found in Tillman's and Taylor's "Water Purification and Sewage Disposal" ($2).

Algae can be destroyed in their early stages of growth by the application of chemicals and thus the nuisance occasioned by their growth can be prevented. They can even be destroyed if the water is not treated until their growth is well along by increasing the dose and repeating it within a few days. But this would only partially remove the difficulty complained of. Two or more light treatments, the first early in the season and the others at intervals as experience may dictate will be much more satisfactory.

Sulphate of copper is one of the chemicals so used. It has been applied at rates ranging from 0.02 parts per million three times a week to one part per million for one treatment and even at three parts per 1,000 where bacteria as well as algae were to be destroyed. The quantity of water in the reservoir can be computed and the corresponding amount of copper sulphate computed. It is put in a bag and towed

around the reservoir under water by means of a boat until it has all dissolved.

The action of the copper sulphate may increase the amount of carbon di-oxide in the water and some chemical treatment of the water at the outlet to remove this acidity may be desirable if the condenser tubes are acted upon materially by the acid water. The number of bacteria, of harmless varieties probably, may be increased by the change in conditions due to the removal of the algae. An amount of say one part of copper sulphate per 2,000,000 parts of water will probably destroy the small animal and vegetable growths in the water and will be a good proportion to start with. The higher proportions will destroy larger animal life, even fish and frogs. Variations from this amount and frequency of treatment must be determined by experience. Various reports of methods of treatment will be found in Rideal's "Water Supplies" (Lippincott) and in the proceeding of the American Water Works Association for 1907, in a paper by T. W. Davey on stripping reservoir land, and in 1906 by James M. Caird, the latter going into much detail as to methods, apparatus and results and costs of various quantities.

Creosote has also been used for preventing growths of algae when applied at the right time, as noted in the same proceedings for 1910, in a paper by W. F. Wilcox.

Liquid chlorine has been used at Wilmington, Del., for the same purpose as described by S. M. Hoopes in the same proceedings for 1913.

Paving of Street Railway Area

We are having considerable trouble with some bitulithic street railway track pavement. The conditions are these:

The rails are standard 56-pound on wood ties spaced 2 feet o. c.; concrete under and about the ties. The top of the concrete extends slightly above the ties. The plans called for a 3-inch surface mixture between the rails of the track, wooden nose blocks being specified for next the rail. The work was built by laying a binder course of bitulithic, on which was laid the wearing surface, about 3 inches thick. The nose blocks were used as specified; also wood blocks were laid just outside the rail.

No provision is made for draining the track. The track pavement is laid in a continuous sheet for a distance of about 2,000 feet.

We find that, within six weeks after the work was completed, the pavement inside and next to the rails began to rise, the upward pressure or force splitting the nose block and carrying half of the block with the raised pavement. The 3-inch surface only is rising, the raised portion extending a foot or 18 inches from the rail. In a few places the pavement is rising slightly outside the rails. The trouble between the rails is so acute that the traction company was forced to pick off some of the surface in order that the cars might pass along the track.

Has such a condition as I describe come to your attention before? Are you able to suggest the probable cause of the trouble and any means for remedying it? This is our first experience with a soft pavement between the rails and we are wondering if such construction is really good practice. Any information or suggestions offered in this connection will be greatly appreciated. E., ———, Mont.

The cause of the trouble is probably due to the fact that a light rail is used. Experience has demonstrated that there must be considerable vibration of the rail where the rail is used as light as 56 pounds per yard and laid with ties on 2-foot centers. This is especially so considering the heavy rolling stock that is now used in most of our cities. Any pavement laid against a 56-pound rail will give trouble where the street car rolling stock is heavy, and this will be so, even if wood or stone headers are used on each side of each rail. The extent of the trouble, which will be due to this vibration, of course depends largely on the sub-foundation.

The remedy for your trouble is to require a heavier rail to be used. If it is impracticable to require a heavier rail construction, then some form of block pavement will be preferable between the rails and for 2 feet outside thereof, thus providing for a minimum expense in replacing the pavement where it is pushed up or heaved.

Collection of Waste Paper

This city is annoyed by the waste paper nuisance. We have been taking the waste paper along with the ashes and other rubbish. Our ordinance requires that all waste paper shall be tied in bundles, but it is practically impossible to get the householder to comply, consequently, when the ashes and rubbish are set out along the curb for removal the waste paper blows all over the streets, and it is put out in such quantities that it amounts to 30 or 40 per cent. of the contents of the wagons, thus costing the city a considerable amount of money, both for its removal and the cleaning of the streets. Have you any information as to the methods of collecting said refuse by other cities, and if there are any which do not remove the paper, requiring the householder to make other arrangements for its disposal?

P., Street Commissioner.

Probably the most complete records regarding garbage and refuse collection and disposal are those in the special report of the Bureau of the Census, giving General Statistics of Cities for 1909, which has special reports on sewers, refuse, street cleaning and highways. From that report it is learned that five cities collect waste paper separately, other rubbish being collected with ashes. These cities are Cleveland, Newark, Louisville, Hartford and Holyoke. All others making the collection include waste paper with rubbish. Twenty-one of them include rubbish with ashes and about eight include rubbish with garbage, a few including ashes also with garbage.

The rubbish contractors in Indianapolis tried to induce a separation of paper so that they could get the advantage of the price at which it could be sold, and refused to make certain collections if they were mixed. A supplemental contract was made covering all classes of refuse, which are now separated practically into garbage, combustible refuse, and incombustible refuse, and all refuse when so separated must be taken by the respective wagons, and paper is collected with other refuse.

There seems to be no method of forcing separations by householders except by refusals to collect unless separations are made and then holding the householders responsible for the private removal of their refuse, and any nuisance produced by its presence, including the scattering of papers.

Correspondence with the cities mentioned may secure information regarding their success with the separation of paper from other wastes. Cleveland, Louisville and Holyoke collected with city forces, Newark and Hartford by contract, at date of report.

Can our readers give any further information on this point?

Clay Treatment of Sewage and Industrial Waste

Can you direct us where to get information on the "Clay treatment of sewage and industrial waste," developed by Professor Rohland, of Germany? If you have any data on the above, kindly let us know how and where we can obtain same, and very much obliged.

S. C., Paterson, N. J.

Can our readers give any information about the process mentioned? The writer is not familiar with it. Clay has been used for sewage precipitation for some thirty-five years, the A B C process being one of the earliest processes employed, the letters standing for alum, blood and clay, but the alum and clay being the materials commonly used. The fine particles of clay attract the lighter particles of organic matter and the sulphate of alumina or other coagulant increases the action of sedimentation.

WORKERS IN THE FIELD

Asphalt Top for Old Brick Pavements

The Editor of MUNICIPAL ENGINEERING:

Sir—Many cities have old brick streets that are in poor condition after many years' wear. But while the old brick is useless as a pavement, it has a high value as a foundation. It is the worst kind of waste to tear up and throw away the old brick instead of making it serve as the support for a new wearing surface. For by using the old brick as a foundation a new pavement can be obtained for a fraction of the cost of new construction from the ground up.

A number of Ohio cities had a lot of old-fashioned brick pavements, full of holes and depressions, and with the brick so badly worn on the edges that the pavements almost presented the appearance of a corduroy road. It was impossible to clean these pavements and to ride over them was a bone-racking experience.

The situation was met by resurfacing these old brick streets with sheet asphalt and asphaltic concrete, and the result after several years' wear is to show that construction of this kind, rightly done, provides a pavement as durable as those placed on a new concrete base.

T. H. Brennan, of the office of the chief engineer of the Columbus department of public service, has made the following report:

"Concerning resurfaced streets, I beg to give you the following information:

Streets	Sq. Yds.	When Laid
Gay street	7,218	1912
Fifth street	2,577	1912
Sixth street	3,979	1912
Monroe avenue	3,300	1913
Wilson avenue	5,037	1914
Bryden road	9,850	1915

"All of the above streets are in first-class condition and there has not been any money expended for maintenance so far.

"Bryden road, from Parsons avenue to Ohio avenue, was resurfaced over old cobble stones with Trinidad asphalt in October, 1888. The cost of maintenance of this 12,573 square yards to January 1, 1915, has been one and seven-tenths of a cent per yard per year The street is in good condition today and probably will be maintained at reasonable cost for several years longer."

Toledo likewise provides a number of examples of successful asphalt resurfacing over old brick. But one of the best examples is found in Youngstown, Ohio. The job in this instance is Wicks avenue, a business thorofare running thru the center of the city. In 1896, this street was resurfaced with but one inch of sheet asphalt, was down ten years, and was then called unsatisfactory and unsuccessful on account of the uneven surface permitting crowding. In 1906, this old one-inch coating was removed and relaid with an inch of binder and two inches of wearing surface. This, after eight years of service, is in excellent condition and not a cent has been expended for repairs, except where cuts were made for sewer or water connections.

Johnstown, Pa., has also met with complete success in resurfacing old brick pavements. Lexington, Ky., has had a similar experience. So have Cedar Rapids, Iowa; Peoria, Ill.; Indianapolis and other cities. In all these cases natural lake asphalt was used and the work was done by men who knew how to do it properly. The writer knows of but one case of failure of asphalt resurfacing over old brick. The failure was in Wheeling, W. Va., and is readily accounted for by the fact that a type of asphalt plant was employed which did not permit of turning out good mixture for any purpose, namely, a direct flame plant. Another factor was the use of a manufactured asphaltic compound which was a failure wherever employed and in the form then marketed was withdrawn from use.

As to the methods of resurfacing over old brick, the first essential in work of this character is that the old pavement shall be thoroly clean. Dirt must be not only swept from the surface but removed from the cracks. This can be done with wire brooms. However it is done, it must be done thoroly. Use of a fire hose will accomplish the removal of dirt even more effectively than sweeping, but if water is used the surface must be allowed to dry off thoroly.

Minor depressions in the old pavement may be brought up to a uniform contour by the use of binder (half-inch stone with about 4 per cent. asphalt cement), but no depressions of more than two inches should be filled in this way. These

RESURFACING WITH ASPHALT *an old brick pavement on Maryland street, Indianapolis. Note evening up of brick surface with concrete; also the grade pins set along the center line and at the quarters. Trinidad asphalt used.*

RESURFACING SIXTH STREET, *Columbus, O., with Trinidad sheet asphalt, using 1½-inch binder and 1½-inch top. Laid in* 1912 *over old brick street. Shows the steps in the process.*

latter should be cut out and filled from sub-base to surface with hydraulic concrete.

To secure perfect adhesion between the foundation and the asphaltic top, the brick or concrete should receive a paint coat composed of equal parts of commercial naphtha and asphaltic cement, applied at the rate of not more than one gallon per square yard of surface.

If a surface heater is available it will pay to warm up the street before the paint coat is applied. Dust or dampness prevents proper adhesion of the paint coat to the brick or concrete. Fill all depressions with concrete or binder as indicated, then clean and apply the paint coat.

As soon as the lighter parts of the paint coat have evaporated, and before it has had a chance to accumulate dust and dirt, the surface mixture should be placed and rolled. Either sheet asphalt with a binder course or asphaltic concrete may form the new wearing surface.

In cases where the curb is very low and for this reason it is undesirable to make the wearing surface two inches thick at the curb, it may be reduced from two inches at the crown of the street to a lesser thickness at the curb. In one case where very successful resurfacing of this description has been done, the asphalt top ranges from two inches at the crown to one inch at the curb, but so thin a wearing surface, even at the curb line, is not recommended as safe practice.

A new cement-grouted brick pavement is one thing. An old, rutted brick pavement with rounded edges on every brick, depressions and holes here and there, and dirt-filled spaces between every row of brick, is an abomination. But cities might be compelled to endure them if the way had not been pointed out to cover these old pavements with an asphalt wearing surface at small cost—very small indeed, considering that the city will get what is virtually a brand new pavement for the cost of a two-inch top.

D. T. Pierce,
Philadelphia, Pa.

Some Conclusions From Observation of Portland Cement in Storage

The Editor of Municipal Engineering:

Sir—These conclusions are not chronicled in the order of their importance. The one of the greatest importance is that water-tight storage is not sufficient, as practically air-tight storage is necessary to insure the cement against injury.

First: The strength of cement stored in bulk is maintained for a longer period than when stored in any other form.

When I say stored in bulk, I mean in bins and not in piles on the floor. This period can be made practically indefinite if the circulation of the air over the top of the cement is prevented.

Second: The strength of cement stored in paper is maintained for a longer period than when stored in cloth.

Third: The closeness of the piling and the tightness of the floor are essentials to the successful storing of cement. In piling cement for storage the arrangement of the piles or ricks should be such as to present the least number of square feet of ends, sides and top of the piles. Care should be taken in piling cement that there are no available air spaces between the bags.

Fourth: A tarred cloth cover over the top, sides and ends of the piles will, to a very large extent, prevent the caking of the cement.

Fifth: There is a saying, "If you would prevent your cement from caking, turn the sacks every month." My observation is that this is a fallacy. Turning the cement merely breaks the very thin cake formed in a month into small particles that feel thru the sack like cement and sand mixed. Turning cement is really a detriment, as it breaks up the thin and partially water-proof cake and presents a fresh supply of cement to be spoiled by contact with the sack. Turning the cement may fool the inspector.

Sixth: Dry storage alone is not enough, it must be air-tight to prevent the caking. The tightness of the floor is not given the consideration that it should have, as it presents means for the circulation of moisture-laden air and at the same time permits the leakage of considerable cement. In fact, the tightness of the floor is almost as important as the roof. We have all noticed the sweating of an ice water pitcher in the summer time. The air which closely surrounds the pitcher is cooled until the dew point is reached.

Two factors which control the moisture-carrying capacity of air are the temperature and the pressure. Any increase in either will increase the capacity of air to carry moisture.

The point that I am trying to make here is that moisture can reach cement in other ways than a hole in the roof or a crack in the side of the building. During a cold snap the cement will very nearly reach the average temperature of the storehouse and, as frequently occurs, the next change brings moisture-laden atmosphere and a falling barometer. The air having free circulation into the storehouse and the piles of relatively cold cement lowers the temperature of the air actually in contact with the cement to the dew point. This gives the cement a coating of moisture. The air being cooled falls by gravity, thus affording a continuous supply of moisture-laden air. This will continue until the temperature of the cement has risen to that of the surrounding air.

Seventh: If cement is to be kept in exposed piles and in perfect condition the temperature of the room must be maintained at a temperature considerably higher than the outside air.

Eighth: Cloth cement sacks are badly injured by the above mentioned deposit of moisture by the air, as the chemical action set up tends to destroy the fibers of cotton of which the sacks are made.

Ninth: An ordinary canvas cover is better than no cover at all, but a tarred canvas cover is practically air tight.

Ten gallons of coal tar, two gallons of good japan dryer and two gallons of gasoline will make a black paint for coating canvas covers, making them water tight.

Covers made of as light as unbleached muslin coated with a good flexible paint are effective in protecting cement from the air.

S. P. Baird, M. Am. Soc. C. E.,
Columbus, O.

LEGAL DECISIONS

Is the Bid Legal?

On January 21, the city council of Iowa City, Iowa, awarded to William Horrabin the contract to construct the new bridge over the Iowa river, at the foot of Iowa avenue, for $77,400. His bid read that he would build the structure for $500 lower than the lowest bidder, and the Wideil Company, of Mankato, Minn., was the lowest bidder at $77,900.

The award of the contract is attacked on the ground that it is illegal, this form of bid not being valid as being too indefinite and not regularly conforming with the requirements of the advertisement and specifications.

Mr. Horrabin, however, seems to be so confident of his position that he says he is willing to take the contract for the bridge and build it under a provision that if the decision in the suit is against him the city shall not be in any way indebted to him for the work.

Other bids were from $86,000 to $89,000.

The Conditions of Recovery for Pollution of Stream

A city constructing a sewer emptying into a stream above the land of a riparian owner does not thereby commit a trespass on the land, tho the flow of sewage with the waters of the stream may invade a substantial right of the owner.

A city maintaining for more than ten years a sewer emptying into a stream does not acquire by prescription a right to maintain a nuisance on the land of a lower riparian proprietor, where the use of the stream was permissive and not under any claim of right.

A city, to establish a prescriptive right to maintain a nuisance by maintaining a sewer emptying into a stream to the injury of a lower riparian proprietor, must show that the user has continued in substantially the same way and with equally injurious results for the statutory period.

A purchaser of land on a stream below the place where a sewer erected by a city emptied into the stream may recover damages sustained, since his purchase, by the pollution of the stream and the air, where at the time of the purchase the fact of the sewage was hardly perceptible, and where the vendor had not recovered damages and the city had not obtained the right to maintain the sewer.—Ansler et al. v. City of Sedalia (Mo.), 176 S. W. 1102.

Decisions of the Higher Courts of Interest to Municipalities

Injunction Against Portable Asphalt Plant Nuisance Not Wanted.—In an action for damages and injunction it appeared that defendant, under contract with the city to pave the street with asphalt in such a manner as to require a high degree of heat, located his plant at a point 175 feet from plaintiff's dwelling. Upon the hearing the judge below found that the operation of the plant caused gritty dust to be thrown into plaintiff's house when the wind was from the south, causing great damage to the furniture; that this dust and the smoke was a menace to the health of plaintiff and her boarders, whereby the latter were threatening to leave, thus seriously affecting her means of livelihood, and that the dust and smoke had produced soreness of one of plaintiff's eyes, which threatened to become chronic. The court also found that defendants were able to respond in damages, that the machine was in the most fitting location to accomplish the work, and that to stop the work would greatly interfere with the public good. *Held*, That the court below properly refused to grant an injunction until final hearing, since, in cases where important public works are sought to be stopped, courts will await a finding of facts by a jury before interfering by injunction.—Jones v. Lassiter et al, (N. C.) 86 S. E. 710.

Water Company Must Supply Automatic Sprinklers without Meter.—A municipal ordinance passed in 1871 authorized a water company to operate a system of water works to supply the city and inhabitants with water and for that purpose to lay pipes in the streets and to charge a sum fixed by a schedule of rates to be established by agreement between it and the city, or by arbitration. Under such ordinance a schedule of rates was established as prescribed, which established that distilleries, foundries, machine shops, locomotives, soap or starch works, and manufactories of all kinds, should be charged at meter rates for the estimated quantity of water used (where meters were not used). A paper mill installed an automatic sprinkler system, a new device for fire protection, and upon its refusal to install meters at its own expense to measure the amount of water used, and to pay $300 in addition to meter rates, the water company threatened to cut off its supply. The mill sued to enjoin such action, claiming that the water company, under the ordinance and schedule, was obligated to furnish water at meter rates, the quantity being estimated, without the installation of meters, which it was alleged would impair the efficiency of the fire protection. *Held*, That the water company was obligated to furnish the mill water at meter rates without the installation of meters, the quantity used being estimated.—Terre Haute Paper Co. v. Terre Haute Water Works Co., (Ind.) 110 N. E. 85.

Conveyance of Abutting Front of Lot Does Not Relieve Remainder of Lot of Sewer Assessment.—The owner of a lot, on which is his residence, by conveying, in anticipation of a street improvement, the front eight feet, reserving the use of it as a means of ingress and egress, with provision that no fence or sidewalk shall be constructed thereon, cannot exempt from assessment the part retained as non-abutting on the street.—Bayes v. Town of Paintsville, (Ky.) 179 S. W. 623.

Water Company Cannot Condemn Property to Sell Water Outside Its Own Municipality.—The Water Company Act of

1876 (3 Comp. St. 1910, p. 3635), Sec. 1, provides that any number of persons not less than seven may form a company to construct and operate water works in any city, town, etc., to supply such city, town, etc., with water. Section 3 provides that any company incorporated thereunder may take and divert springs and streams of water necessary for the purposes of its incorporation. Section 5 provided that, if it cannot agree with the owners of any lands from which it may desire to divert any springs or streams as to compensation, condemnation proceedings may be resorted to. *Held*, That such a company may only exercise the power of eminent domain for the purpose of acquiring water and water rights reasonably necessary for the supplying of water to the municipality in which its works are located and the inhabitants thereof, and water required by it for the purpose of supplying other municipalities with which it has made contracts must be obtained by purchase from or agreement with those controlling such water.—Mayor and Aldermen of City of Paterson v. Montclair Water Co., (N. J.), 94 Atl. 889.

A water company organized to supply the township of W. and its inhabitants with water, which, under color of eminent domain proceedings, brought ostensibly to obtain water for such township, diverts from a stream water for the further purpose of supplying other municipalities with which it has made contracts, is guilty of a fraud on the state, and liable to make compensation for the injury resulting from its wrongdoing.—Mayor and Aldermen of City of Paterson v. West Orange Water Co., (N. J.) 94 Atl. 891.

City Liable for Damage from Its Electric Wire Wrongly Placed.—Where a wire connecting a house with the city's power line was so strung that a wire clothesline, when raised by a pole, as is customary, would come in contact with it, such wire connection with the power line was negligently defective, since due care requires that conductors of electricity be so placed with reference to similar conducting agencies that dangerous contacts are not probable.—Elias v. Mayor and Board of Trustees of City of New Iberia, (La.) 69 S. W. 141.

Who Pays for Defective Water Pipe Passed by Inspector.—Where iron pipe is sold, "subject to inspection," is inspected and accepted, and after being used in the construction of a water works system is found in part defective, and it is not shown that by a proper inspection such defects could not have been discovered before said pipe was used, there can be no recovery on the part of the purchaser, upon the ground that, notwithstanding said pipe was inspected and accepted, there was an implied warranty on the part of the seller that said pipe was adapted to the use for which it was bought.—Sherman v. Sheffield Cast Iron & Foundry Co., (Okla.) 159 Pac. 1062.

Jitney Bus Ordinances Valid.—A municipal ordinance, regulating jitney busses and requiring a permit and bond and the payment of a license fee, is not void in providing for a classification based upon the amount charged for transportation.

A provision in a city ordinance making it unlawful to operate a jitney bus unless the operator has thirty days' experience in operating an automobile in the city, is not an unreasonable exercise of the police power.

A municipal ordinance regulating jitney busses and providing that the owner or lessee must give a bond in the sum of $10,000 conditioned for the payment for all injuries from the negligent operation or defective construction of the jitney bus or from violation of statutory ordinances, or a policy of insurance insuring the owner or lessee against loss by reason of damage to person or property from the operation of the jitney bus, which policy shall aggregate $10,000, is not invalid, being within the scope of the power of the municipality.

A municipal ordinance requiring the owners or operators of a jitney bus to give a bond in a certain sum, conditioned upon payment of damages for injuries to person or property, is not invalid in requiring the bond to be that of a surety company.—Ex parte Cardinal, (Cal.) 150 Pac. 348.

An ordinance of a city regulating the operation of jitneys using streets for local transportation and requiring operators to give a bond for the protection of citizens, does not deny due process of law merely because it provides for a forfeiture for certain infractions of the ordinance.

A city having exclusive control of its streets, with power to grant franchises for their use, and to license trades and business, may prohibit the use of streets for the private business of one operating a jitney as a common carrier of passengers, or may give permission for such use and compel the payment of a license fee.

A city charter authorizing the granting of franchises for the use of streets for a public purpose, covers any franchise subject to thte limitation that it must be made in the interest of the public, and the authority conferred is not confined to granting franchises only to individuals and corporations granted a designated right of way.

Under a city charter authorizing the city to license trades and business, and charge license fees which shall not be construed as occupation taxes, a license fee, imposed for the use of streets for jitneys as carriers of passengers, is not an occupation tax.—Greene v. City of San Antonio et al., (Tex.) 178 S. W. 6.

Damage from Sewage in Stream.—Under Const., Art. 2, Sec. 22, providing that private property shall not be taken, appropriated or damaged for public use, without just compensation, a municipality or sewer improvement district, while entitled to obtain outlets outside the corporate limits, cannot take or damage property without just compensation, and in case they turn sewage into a stream, to the injury of lower riparian owners, the damages should be assessed on the theory of a permanent taking under a right of eminent domain.

That a sewer system and outlet were put in operation in 1910, and sewage discharged for three years thereafter in a stream on which plaintiff was a riparian proprietor, does not bar his action to enjoin the maintenance of the nuisance.

Where a sewer system was negligently maintained so that it constituted a nuisance, the nuisance will be enjoined.—Jones v. Sewer Improvement Dist. No. 3 of City of Rogers, (Ark.) 177 S. W. 888.

Water Company's Liability for Fire Loss.—A water company contracting to furnish water thru plaintiff's fire pipe line, which plaintiff was to keep in repair, in protection of its property in the water could refuse to perform its contract while the line was out of repair and wasting the water, and, if the loss occurred during such time, was not liable.

In an action to recover for the loss of property destroyed by fire, alleged to have resulted from the breach of defendant water company's contract to furnish water to plaintiff's fire pipe line, the measure of damages was the value of the property actually destroyed by the fire, and within the contemplation of the contract. In such case the amount of the insurance collected by the plaintiff was to be applied to the reduction of the damages pro tanto.—Warren Co. v. Hanson, (Ariz.) 150 Pac. 238.

Damages for Destruction of Shade Trees by Street Improvement.—At common law, where no compensation was allowed the abutting owner for authorized highway improvements, such as a change in grade, municipal authorities could destroy shade trees in the street without compensation. Under Village Law, authorizing an award of compensation to owners of realty affected by a change in grade of a street, damage to the land from the destruction of shade trees in the street may be recovered by the owner, since the purpose of the statute is to impose liability whenever the land adjacent to the street is injuriously affected. Goodrich v. Village of Otego (N. Y.), 110 N. E. 162.

FIRE DEPARTMENT

Motor Apparatus in Fire Departments

Superintendent of Public Safety, Mr. P. S. Harmon, city of Williamsport, Pa., submits the following statistics covering comparison of a horse-drawn and motor-driven chemical engine for period of December 1, 1913, to December 1, 1914:

"During the 365 days in which the records were kept the motor-driven apparatus responded to ninety-nine alarms. The engine responded to sixty-nine alarms and went into active service at only three.

"The cost of the fire engine and horses for upkeep aggregated $312.64 for the year. This cost is divided as follows: Feed and hay, $272.89; shoeing, $31.75; coal, 8, making an average cost of approximately 85 cents a day. The cost of maintenance for the motor chemical totaled $48.10, divided as follows: Gasoline, $25.20; oil, $9; repairs, $13.50, an average of about 13 cents a day."

NEW DOVER, N. J., COMBINATION.

A quite recent addition to the motor-driven apparatus operated by the fire department, city of Dover, N. J., consists of a self-starting, 6-cylinder, 60-h.p. White motor combination chemical and hose truck.

Twelve hundred feet of 2½-inch hose are carried in a steel hose bed which is quickly accessible from the rear running board. This bed occupies the conventional position between two seats running lengthwise of the machine. These seats, which are capable of seating eight firemen, have cushions that are deep and soft. Beneath each row of seats are large lockers. Hand chemical tanks are strapped to the running board and the large nozzles for the 2½-inch hose are carried on posts that are built on the rear running board. Hooks, lanterns, axes, etc., are carried on the spring catches and hooks along the side of the body. A 50-gallon chemical tank is mounted in the customary place in a recession between the driver's seat and the hose bed, while the chemical hose, 250 feet long, is coiled in a steel basket immediately above the chemical tank.

FUNCTIONS OF MOTOR GENERATOR.

The motor generator, mounted at forward left side of engine and driven by a silent chain, performs both starting and lighting functions. The entire control is centered in a single knife-blade switch located on the dash. When the driver has closed this switch the electric system assumes its duties and performs every function without any further attention and without the assistance of any automatic regulating devices.

Closing the switch connects the nine-cell battery and puts the motor in operation, thus starting the engine. As soon as the latter is turning over at a speed in excess of a few hundred revolutions per minute, the generator being a slow-speed type, the voltage of the motor generator exceeds that of the battery, and the battery is charged at all speeds above this point, at a definitely governed rate. The 18-volt storage battery is "floated" on the line in such a manner that the motor changes to a generator and back again to a motor, according as the electrical pressure rises or falls above or below that of the battery.

At engine speeds above a certain definite point it is a generator and below that point it becomes a motor, so that should

TRACTORS IN FIRE DEPARTMENT SERVICE.

KNOX-MARTIN TRACTOR, MT. VERNON, N. Y. WHITE TRACTOR, CLINTON, IA. SEAGRAVE TRACTOR, COLUMBUS, OHIO.
WHITE TRACTOR, OCEAN GROVE, N. J. AMERICAN-LA FRANCE TRACTOR. WHITE TRACTOR, CHICAGO, ILL.

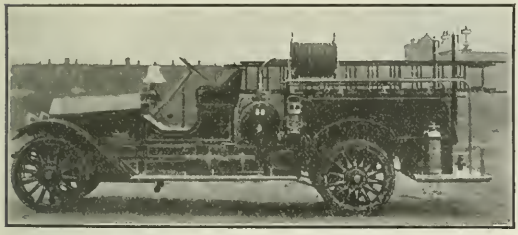
the engine stall in traffic the electric motor will automatically "pick it up" and restart it, without any attention on the part of the driver. It will be apparent that this should constitute a very valuable feature of the motive power of any piece of fire apparatus, where the delay incident to having to restart the motor by hand-cranking might be serious.

CHIEF'S CAR FOR WINONA.

The city of Winona, Minn., recently awarded a chief's car contract to the Mitchell-Lewis Company. This roadster carries two powerful fire extinguishers on the running boards. "In the rear compartment," states Chief Norton, "is a large chemical tank, entirely concealed, built to carry a pressure of 250 pounds to the square inch, while in the rear of that is a reel of fire hose 200 feet in length. By means of a by-pass and a valve, the contents of the big fire tank may be discharged thru a regular hose lead, should we happen to arrive at the scene of the fire when a 3-inch hose is available. Thru the 1-inch hose on the reel, with a small nozzle, the chemical may be sent against a fire in one minute after the chief arrives. One big efficiency feature of this rig is the fire-extinguishing equipment, which one man, making a speedy run to a fire, may use and do more effective work than two or three companies of firemen arriving later, no matter how complete their apparatus."

MOTORS START WHEN GONG SOUNDS.

The city of Orange, N. J., has completely motorized its fire department. The motor equipment consists of one 6-cylinder 60-h.p. motor hook and ladder truck; one 6-cylinder 60-h.p.



BOYD COMBINATION HOSE AND CHEMICAL.

motor truck used as a tractor to motorize a horse-drawn hook and ladder; three 4-cylinder motor combination chemical and hose trucks, and a 4-cylinder 30-h.p. chief's roadster.

"Every piece of motor apparatus is equipped with an automatic starter," states Chief William H. Matthews. "Furthermore, all the motors are automatically started when an alarm is sounded. The self-starting switches are operated by a device synchronized with the alarm system and the engines are started the moment the gong sounds. In winter all of the machines are provided with warmers to keep the water in the radiators heated, thus preventing any delay due to the water and engine becoming chilled.

"One of our first motor-driven pieces consisted of a White motor combination chemical and hose truck. This machine, installed November 4, 1912, answered 162 alarms the first year at an operating cost of $51.83, including tires. For the second year of its service the cost advanced to $83."

PHILADELPHIA RAPIDLY MOTORIZING.

In its 1914 report the fire department, city of Philadelphia, Pa., makes the following mention of motor apparatus, showing an increase of $275,427.25 in motor apparatus as contrasted with a reduction of $21,866.30 in horse-drawn equipment:

KISSEL CHIEF'S CAR.

Motor-Driven.

Motor apparatus in use at the end of Dec., 1914	$138,514.58
Amount expended for motor apparatus in 1914	200,000.00
Total investment in motor-driven apparatus	$338,514.38

Horse-Drawn.

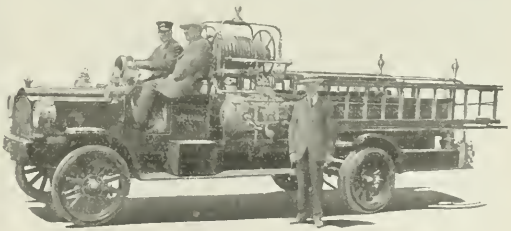
Horse-drawn trucks	$ 44,025.00
Combination chemical and hose wagons and water towers	90,275.70
Horse-drawn pumping engines	252,058.50
468 horses at $190	88,920.00
Total investment in horse-drawn apparatus	$475,279.20

BOSTON PROTECTIVE DEPARTMENT.

The Boston Protective Department, now operating four White motor trucks, as well as a roadster, submits the following report:

"One of our White trucks, placed in service August 7, 1912, has run about 12,000 miles and responded to more than 2,000 calls. The other three Whites were put in commission November 10, 1914, and, being new, have been called upon to do the brunt of the work ever since. These machines are of the 6-cylinder type, 60-h.p., 161-inch wheel base. They weigh 6,300 pounds empty and about 9,000 pounds equipped, not counting the men. Each of them carries twenty-five covers, 12 by 18 feet in size, and, in addition, a full supply of extra sprinkler heads, shut-offs, fusible links, plugs and caps for gas pipes, extinguishers, squeegees, axes, hooks, short ladders, life nets and other appliances. The Boston Protective Department is maintained by the fire insurance interests at an annual expense of about $115,000. It employs sixty-three permanent men, owns about 900 covers, with a full equipment of appliances for quick, practical work at fires. It has been in operation for nearly fifty years."

THE CITY OF McKEESPORT, PA., *purchased a 3-ton Packard truck, which was delivered on May 4, 1914, and which has since proved itself of great value in the McKeesport fire department. As the illustration shows, the truck is a combined chemical, hose and hook and ladder vehicle, carrying, besides several hundred feet of standard water hose, two chemical tanks and hose on reels, ladders, fire extinguishers, etc.*



LOW SIX MONTHS' RECORD.

The Young America Hose Company, Poughkeepsie, N. Y., submits the following report on a White combination placed in service in November, 1911:

"The operating cost per six months averages approximately $15, whereas the cost of keeping the team of horses displaced by the motor apparatus amounted to $260. This outfit, which is mounted on a regulation White 1½-ton chassis, carries both stationary and portable chemical tanks, and the full complement of hose, nozzles, extension ladders, hooks, axes, etc. The larger stationary chemical tank employs what is known as the Kanawha system, in which the creation of pressure does not depend upon the usual chemical action, but is accomplished by a powerful auxiliary air-pressure system. On the running board there is a steel tank of compressed air, with a conveniently located pressure gage. In the line from the air tank to the chemical tank there is a pressure regulating valve, enabling the firemen to admit air to the chemical in accordance with the requirements of the blaze or the consumption of chemical."

Big Reduction in Insurance

The fire department, city of Wilkes Barre, Pa., during the past year added nine pieces to its motor-driven list, bringing the total to thirteen. Of the eight companies, five are now completely motorized, effecting a saving of $8,000 per annum. Twenty-seven horses were eliminated.

Fire Chief Hochreiter furnishes the following conclusions:

"Our thirteen motor-driven pieces, which include seven combination chemical engines, one flying squadron car, one ladder truck and four pumping engines, average in upkeep $3 a month, which includes gasoline, oil and repairs. At this rate it costs $39 a month, or $468 a year, to keep thirteen pieces of motor apparatus.

"Aside from the tremendous saving effected by the elimination of twenty-seven horses, the Fire Insurance Underwriters reduced the cost of fire insurance in this city to the amount of $13,000 in premiums a year. This reduction was granted before the nine new pieces were purchased and before the full-paid department was established. It costs us less to keep thirteen pieces of motor apparatus than it does to keep one team of fire horses. The cost of keeping a piece of motor apparatus varies, as some months it may be driven to more fires than others. The tractor attached to No. 1 pumping engine one month cost as low as 90 cents and the tractor of No. 3 engine 60 cents."

Fighting Theoretical Fires With Building Plans

Director of Public Safety Carroll, Marshal David Walker and Battalion Chief Boughner, Fire Department, Grand Rapids, Mich., are inaugurating new safety measures whereby theoretical fires will be fought by means of building plans.

Plans are now being made of all the larger buildings in Grand Rapids. With these plans on file in the fire department the officials will be prepared to "fight a fire before it occurs." This is done in Cleveland and Detroit in particular with excellent results.

The officials each day take a plan of a building and then set an imaginary fire on one of the upper floors or in some other place difficult to reach. Imaginary lines are laid and the fight is waged on paper just as thoroly and with the same generalship that an army officer plans and executes a battle.

The plans enable the officials to learn the building thoroly and from the basement to the top floor the building is figuratively fired and extinguished. This system, coupled with the personal inspection of the buildings as now is being done, will insure a far greater measure of efficiency, it is believed.

TAKE PLANS TO FIRE.

Further, it is proposed to have these building plans carried to any large fire by the marshal. As executive officer he will be able to leave the detail work to his subordinates and give orders intelligently regarding the methods of conducting the battle which seem most certain of success.

Added to this system will be a closer relationship between fire department officials and the city building inspector. All changes in buildings will be noted as they occur and thus the possibility of the firemen meeting an unusual situation, such as was found in the St. Andrew's school fire, will be eliminated. Particular care is to be paid to the large furniture buildings in the city.

WILL LETTER FIRE HYDRANTS.

It is proposed also to letter all fire plugs with the size of the mains they open and the direction in which the mains run.

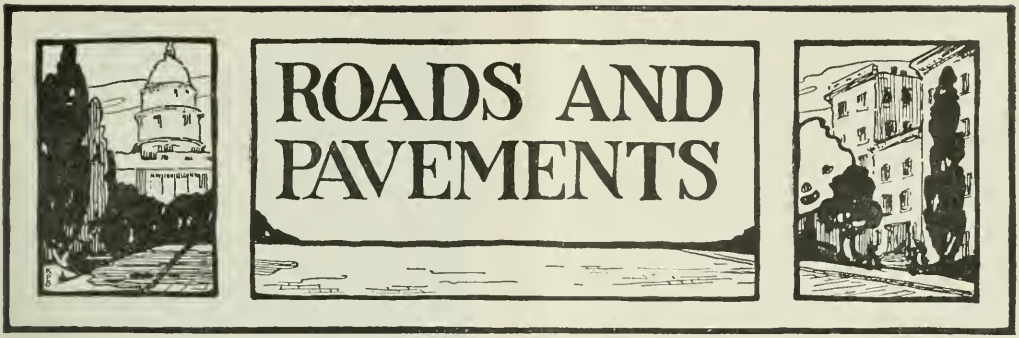
The captains of the various districts, of course, know exactly the size of the mains in their territory, but it is pointed out that a captain from the south end called to the north end may not be aware of the size plug to which he is attaching a line and the lettering will save valuable time and may avert serious complications. It frequently has occurred that two engines have been attached to a small main with the result that neither apparatus could do much good.

Fire Department Notes

William Guerin started in the New York fire department as a fireman in 1889, when Hugh Bonner was chief. He worked his way up the ladder, earning promotion through the successive grades of engineer, lieutenant, captain and deputy chief. He missed by a fraction of 1 per cent. appointment as head of the department, but

Bernard J. Reilly has been a member of the fire department of Ithaca, N. Y., for nearly twenty years. He was promoted to second assistant chief in 1913 and to chief of the department in 1914. Many improvements have been made in the department during the brief period of his administration, including a new automobile squad wagon, two teams of horses and 3,000 feet of hose, new insulated weather-proof wire for the fire alarm system and increase in number of alarm boxes and battery equipment. Additional hydrants have been put in and a system of daily inspection of all the hydrants has been inaugurated. Each fireman now has twenty-four hours off duty each ninth day.

William C. Dowty, chief of the fire department of Hamilton, O., has been in the department since 1878, as substitute driver two years, regular driver thirteen years, fire marshal two years and chief of the department ten years. The entire department will be motorized within the next year, having now chief's car, two hose cars with small chemical tanks, and a hook and ladder truck. The force now consists of twenty-nine men. The fire loss in 1914 was the lowest since 1905, and was only 41 cents per capita, $14,535 in all, altho the 281 alarms responded to made the record as to large number. The small loss is attributed to the motor apparatus and the extensive use of the chemical apparatus.



American Granite Block Pavements Improved to Equal Foreign Pavements

Stone cobbles, blocks or slabs, irregular or regular in shape, according to the abilities of the maker, laid on the ground in close contact, and rammed in place to provide a surface free from mud or dust for pedestrian or vehicular traffic, were the earliest forms of pavement, according to Henry Welles Durham in a paper before the Worcester Road Congress, and were almost the only forms until the invention of the road roller made possible sheet pavements from macadam or ground up to concrete and asphalt pavements.

The old streets of Pompeii show today pavements not inferior (if we disregard their narrowness, due to the different traffic conditions of earlier times) to those of many modern Italian cities, or for that matter, our own. There may be still seen ruts or grooves worn by traffic not dissimilar to photographs displayed as horrible examples by recent volunteer citizens' committees, to prove the impropriety of using for pavements any material subject to wear.

If by the expression "improved granite pavements" we seek to convey the impression that there has recently been discovered some marvelous new method for constructing pavements of stone blocks much superior to anything heretofore known in the history of the world, we shall be guilty of falling into the error so frequently incurred in this country, of supposing that all of the improvements in conditions we make are original with ourselves. What should be signified by the term, is the classification of those stone pavements suitable for present day traffic conditions, as opposed to the many makeshifts which have been permitted, either thru ignorance or lack of study, to disgrace the appearance of streets of American cities in past years, and which unfortunately, most frequently even at the present time, present themselves to the mind of the average citizen when the term "stone block" or "granite pavement" is used.

Looking briefly into the history of stone pavements in our country alone, it will be found that up to well into the latter half of the past century, pavements of cobbles were about the only type employed.

During this period and down to the last decade of the nineteenth century were introduced different types of squared stone block pavements varying from large slabs to small cubical blocks, and employing trap rock, granite, sandstone and limestone in accordance with the locality. Granite and trap rock being easily obtained for our more populous eastern cities, were largely used here, while for similar reasons, blocks of sandstone and limestone were introduced in the middle west, and basalt on the Pacific Coast.

About the time that sheet asphalt pavements were gaining in popularity in 1890, the pavements employing oblong granite blocks laid transversely to the axis of the road, and with joints filled with tar and gravel came into general use. The term "Belgian Block" was applied indiscriminately to this and to the earlier cubical trap blocks, from the fact that stone pavements were almost universal in Belgium, but as applied here, the name was somewhat libelous, as no citizen of Belgium, before its devastation, would have recognized any similarity between the so-called Belgian block streets of America, including Broadway and Fifth avenue, and those of his own country.

Very little improvement was made in American stone pavements for many years after the oblong paving block came into general use, although the bicycle first, and following it, the automobile, was creating demand for a street surface as durable and dustless as the old macadam had been, and this demand was being met by the introduction of continually improved forms of asphalt construction, as well as many types of smooth block, such as wood and brick.

Up to about 1909 it was popularly supposed in this country that stone pavements were of an inferior type. No serious attempt to obtain good faces on the blocks was undertaken. Specifications were not rigid, and there was no interest taken by the quarries in the production of a type of block which could be laid with joints narrower than from ¾ of an inch to an inch. They were from 7 to 8 inches in depth, frequently 12 or more inches in length, and not carefully selected as to width. Examples of the type that was then considered standard may be seen today in the temporary pavements which have been replaced over completed subway construction in New York City pending a final settlement of the back-filled material, and unfortunately, in the form of permanent pavements in many of the important streets in the heart of Boston, but the growing popularity of asphalt, brick and wood blocks, had been leading gradually to the cessation of the construction of new stone block pavements with the result that there was no market for the surplus product of the quarries. As an outgrowth of this situation, and at the instance of paving engineers in such cities as Newark, N. J., and Worcester, Mass., followed by those in New York City, certain of the more enterprising producers of granite initiated the production of more accurately shaped paving blocks which should approach to European first-class specifications. While it cannot be said that even yet we have reached the condition where paving blocks are turned out equal to the best abroad, still, considering the very high cost of labor in this country, we have succeeded in producing a block capable of laying a surface which will compare very favorably with the foreign type. It is in this sense that the term "improved granite pavements" is used to refer to those which have been constructed in the United States during the past six years. Comparison of conditions in regard to this type of road surface in our country and abroad, brings out a very strong contrast. Stone pavements there are taken as a matter of course for the streets in which they are considered desirable. There is

no well-defined modern or improved type as contrasted with the old. Engineers merely classify them in accordance with methods of construction deemed most suitable for varying conditions of cost, location, traffic, etc. This was brought out very clearly by the engineers attending the Third International Road Congress in London in 1913, from the different countries.

Brick Surface Affords New Lease of Life for Macadam

The utility of macadam as a base for brick pavement, after it has otherwise outlived its usefulness, has been proven again, this time in Cleveland. One of the fashionable thorofares of the eastern section of the city is Cedar Glen Road, extending from the intersection of Overlook Road and Euclid Boulevard to the city limits. The greater part of this distance is a slope of varying grade, and the rather heavy traffic is very largely made up of motor vehicles which exert more than their average tractive power when going up the hill. The road leads to the rapidly growing Cleveland Heights and Shaker Heights districts. All the vehicles used in this newest and smartest residence district average two trips a day at least over the road. Pleasure vehicles, delivery wagons and the heavy trucking that results from widespread building operations all use this route.

The original improvement was Telford macadam, laid with great care according to the most approved specifications. It was designed to be not only durable but to reflect an air of luxury. The heavy grade made winter conditions a menace to vehicles and, the chains on automobiles simply chopped it to pieces, doing sometimes as much as $1,000 damage in a single winter day.

The surfacing was soon destroyed and the heavy stones of the Telford base projected. It was decided that repair was out of the question and that thoro resurfacing was needed. The consideration of materials led to the choice of brick.

The projecting portions of the base were removed by hand sledging and redistributed. In some cases, the broken chunks of stone were as much as four inches in diameter. After the irregularities had been removed, it was given a surface of slag, of about the size to pass a 2-inch screen and and be retained by a 1-inch screen. Smaller granulated slag was used to fill the interstices of this slag. The whole was then sprinkled and rolled to an even surface.

Upon this was placed a sand cushion, $1\frac{1}{2}$ inches in thickness, which was given the customary treatment of rolling, striking off to grade and rerolling. Hillside block was used for the entire stretch.

The contract was completed in August of 1914, and the pavement has therefore had a year's test. Traffic has naturally increased very greatly.

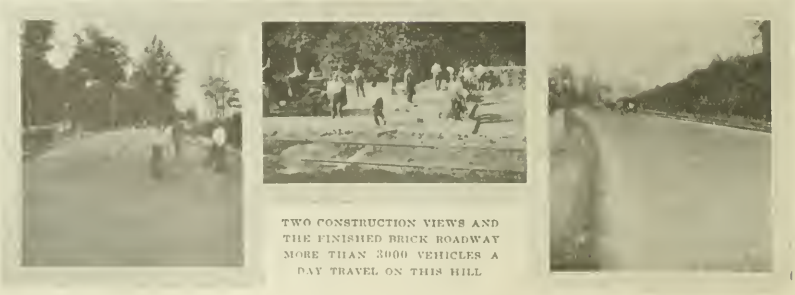
An estimate of 3,000 vehicles a day, made during the current year, is probably rather less than the actual volume. The

LAYING AND ROLLING *brick surface on old macadam base on Cedar Glen Hill, near Cleveland, O.*

results have been, on the whole, commendable aud yet such as to point out certain necessities for this type of re-construction work. Perhaps the most important lesson is the necessity of thoroly compacting the base before the brick course is laid. This was particularly difficult to do here, on account of the extreme roughness of the old Telford macadam base and the necessarily varying thickness of the slag course.

The experiment is of particular interest in a locality where a large amount of macadam has been laid, constituting an investment that citizens are loth to see lost. Much of it is maintained at a cost which will make re-surfacing with brick an economy. This is particularly true upon the heavier grades, which are found abundantly in this section. Whether or not it would have been advisable on account of the heavy traffic to have laid a rigid base for the brick on Cedar Glen Hill, there is a considerable mileage of other roads and streets upon which the question of simple resurfacting with brick will arise, because of the desire to avoid the expenses of a rigid base.

The improvement in question follows the practice of Engineer Ett Smith of Mahoning county with respect to wornout rural road improvements, but was tried under vastly more trying conditions. It is a close approach to the divlding line between the road that may be resurfaced and the one which must be thoroly repaved. No one can doubt on inspecting the result that Cedar Glen Hill will afford satisfaction to the public for many years to come and that there is a wide field of usefulness for brick as a restorer of worn out roads that have been first improved with less enduring material.



TWO CONSTRUCTION VIEWS AND THE FINISHED BRICK ROADWAY MORE THAN 3000 VEHICLES A DAY TRAVEL ON THIS HILL

Sanding Sidewalks in Slippery Weather

With the use of a homely, yet efficient sander, the number of accidents caused by icy sidewalks at Grand Rapids, Mich., has been reduced 95 per cent this season. A bin six feet long, two feet wide at the top and two feet deep was mounted on a pair of wheels. A piece of perforated steel, with rows of one-quarter-inch holes four inches apart extending the entire length was used as a bottom. Over this was placed a similar piece of steel, governed by a lever. The bin, filled with moist sand, is driven about the streets, leaving behind fifteen trails which afford ample protection to all pedestrians. Each load is good for a half-mile and the hill district is usually covered in one day.

Plans for motorizing the sanders and covering the walks of the entire city are now being figured on by Lewis D. Cutcheon, manager of the board of works.

Chicago Paved 147 Miles During 1915

M. J. Faherty, president of the board of local improvements, city of Chicago, has compiled a report showing that 147 miles of Chicago streets and alleys were paved during 1915. The aggregate cost was $4,500,000. The same report shows that during 1914 approximately 160 miles of paving work was done. Officials of the city say that probably the work to be done this year will total 200 miles.

FIFTY MILES OF ASPHALT.

The official report shows that during 1915 fifty miles were paved with asphalt. The other work done and the materials used were: Asphaltic concrete, 19.5 miles; asphaltic macadam, 34 miles; brick, 21.5 miles; creosoted blocks, 4 miles; granite blocks, 3.5 miles; concrete, 14.5 miles.

The new work was in many sections of the city, altho among the most important special assessment contracts were those in the South Chicago district, done at a cost of $196,500; the Cheltenham district, totaling $108,000, and Wentworth avenue, from Twenty-sixth to Thirty-ninth street, where creosoted blocks were used. The assessment for this work totaled $101,000. Other extensive improvements were made in Ravenswood, Englewood and in the Austin districts.

Oscar P. Chamberlain, vice president of the Dolese & Shepard Company, says that the heavy demand for crushed stone for street and road improvement during the year was for improvements thruout Cook and the neighboring counties.

ROAD BUILDING NORMAL.

Practically normal conditions prevailed in outside road building and small town street improvements. The operation of the state-aid road law resulted in increased activity during the year.

Mr. Chamberlain estimates that approximately 1,500,000 yards of crushed stone were used in the city. He says that from September to the close of the year business increased 40 per cent. over the same period in 1914.

John A. McGarry, of the John A. McGarry Company, in summing up the paving activities, said the character of the work done in Chicago in 1915 compared favorably with similar contracts in any city in the United States. Mr. McGarry says the taxpayers are now getting work done at fair and reasonable prices.

From Ancient Granite to Modern Wood Block

In 1820, when the city of New Orleans, La., decided it was tired of miring in its muddy streets in wet weather, it cast about for paving material, of which there was at that time little variety. There was no stone in the vicinity of the city, so the municipal authorities offered a premium for Belgian blocks, sometimes brought to the port of New Orleans as ballast by vessels in the European trade. Those blocks were of large proportions, approximately 15 inches square on top and

PAVEMENT NEARLY ONE HUNDRED YEARS *old being removed to replace with wood block.*

12 or 14 inches deep. Many streets were paved with them, and their durability is evidenced by the fact that many still remain in place after nearly a century of use. A trip over them today in a wheeled vehicle is a jarring experience, and they are fast being removed to make way for modern pavements. The picture herewith shows the Belgian blocks in one of the streets of old New Orleans—Exchange street, adjoining Royal—torn up in November, 1915, to be replaced by up-to-date creosoted wood blocks, for which the city has recently given large contracts.

Good Roads Notes

That all the roads of a state cannot be improved simultaneously and that the most used arteries of communication command priority, is again exemplified in Missouri, where, at Sedalia, the Permanent Road Improvement Association was recently organized. Thirty cities of the state, including St. Louis and Kansas City, were represented in the meeting, the keynote of which was the great value to the commonwealth of connecting its centers of population and at the same time providing for ultimate attention to the feeder roads which will fit into the most important highways. The Permanent Road Improvement Association believes that there should be a logical federal co-operation with the several states, with federal

money utilized with state money in the building of the post roads, which must accept the greatest burden of traffic.

At present more than half of Arizona's prisoners are employed in highway and bridge construction camps. In addition to the fact that the utilization of prison labor in this way affords healthful employment for the men and encourages the upbuilding of character, it has been found that road and bridge construction accomplished under this plan is more thoro than that which can be obtained with day labor, chiefly for the reasons that the prisoners are kept steadily at one branch of work and become proficient therein, whereas day labor proves to be more or less transient. The cost of prison road construction, as compared with that performed under contract, does not vary materially, except in the quality of the work done. The preceding statement, however, does not apply to those road and bridge camps where honor men without guards are employed. In such camps the expense is so materially reduced as to constitute in itself an additional indorsement of prison labor. The plan of employing prisoners on highways, generally speaking, has worked out admirably in Arizona, and now receives the hearty indorsement of those officials under whose immediate supervision the roads and bridges are built. It has proved to be both humane and practical.

A recent trip over the Quebec-Miami route, known now as the Atlantic Coast Highway, showed that it was possible, by making some slight detours, to travel from New York to Jacksonville, 1,000 miles, by the route selected, with less than 150 miles of uncompleted highway, in stretches of 1 to 27 miles, all graded and some being surfaced, only about 25 miles remaining unprovided for when the work in progress is completed.

Crushed stone dealers of Indiana, after a two days' convention, worked out standard specifications for macadam road construction which the dealers will attempt to have county commissioners thruout the state adopt in ordering road improvements. The association engaged the services of prominent engineers to aid in forming the specifications. Fred W. Connell, secretary of the organization, will have charge of the campaign of education among the county commissioners. At their banquet Edward Barrett, state geologist, spoke on "Why Macadam Roads?"; J. R. Fleming on "Value of Good Roads;" Charles A. Caruth, of the New York state highway department, on "Macadam Highways."

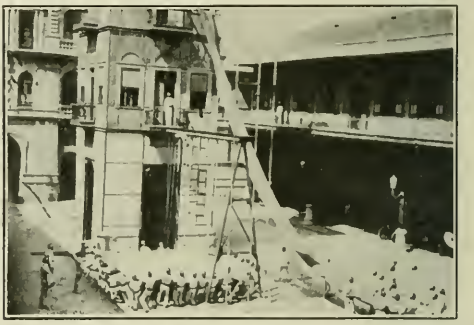
Paving for Minneapolis

The city council of Minneapolis, Minn., has the following comprehensive plan of street improvement under consideration, with prospect of completing the whole, as it is the result of numerous conferences of the council committee on paving and represents the general opinion as to what improvements should first be made:

Central avenue and Division street, between Central avenue and east city limits	$180,000
Minnehaha and Twenty-seventh avenues S., between Twenty-seventh and Fiftieth streets	149,000
Lowry avenue N. E., between Marshall street and east city limits	115,000
Seventh street N., between Hennepin and Plymouth avenues	99,000
Lyndale avenue N., between Twenty-sixth and Forty-second avenues	95,000
Chicago avenue, between Lake and Thirty-ninth streets	59,000
Fourth street N. E., between Lowry and Thirteenth avenues	40,000
Fourth avenue S., between Lake and Thirty-eighth streets	30,000
Blaisdell avenue, between Twenty-sixth and Elroy streets	30,000
Nicollet avenue, between Thirty-eighth and Forty-second streets	26,000
Royalston avenue, between bridge and Sixth avenue N.	25,000
West Twenty-second street, between Hennepin avenue and Lake of the Isles boulevard	23,000
West Twenty-fourth street, between Hennepin and Irving avenues	13,000
Total	$884,000

Fire Department Drill in Rio de Janeiro, Brazil

Rio de Janeiro, Brazil, has a well organized and equipped fire department, one of the best in South America. The photograph shows the tower used by the department for training and drilling the men. A man is about to drop into the life net shown on the left and held by some forty men. A long canvas tube used for life saving is seen on the right of the tower. It is attached to a third-story window and the lower end is held out by a number of men. Fire victims and their rescuers slide thru this tube to safety, one after another. Men are seen holding the end of the tube out so that it can be used without



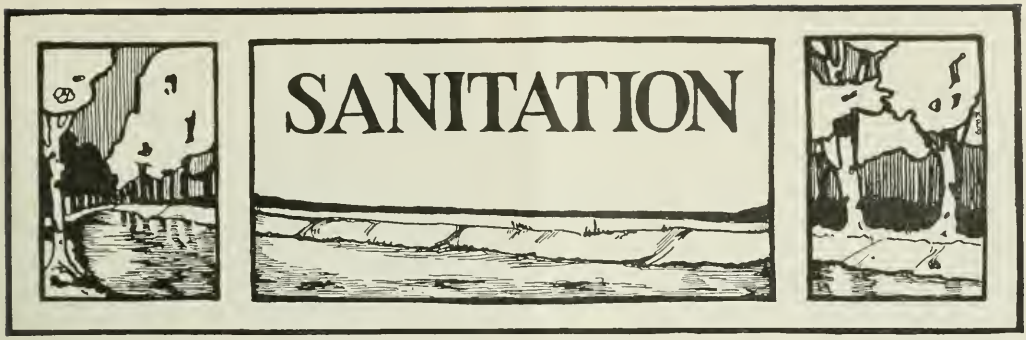
the slider striking the ground until he has lost his falling velocity in the flat part of the canvas near the bottom, in which his weight causes a sag to aid in this.

The tower is used also to train men in scaling walls with and without ladders and it is a familiar sight during drill hours to see a man clinging to whatever projections he can find and thus gaining confidence and facility which he can make use of on buildings actually on fire.

Portland Cement Production in 1915

An estimate of Portland cement produced in the United States in 1915, just made by Ernest F. Burchard, of the United States Geological Survey, indicates that the shipments from the mills amounted to 86,524,500 barrels, compared with 86,437,956 barrels in 1914, an increase of 0.1 per cent; the production was about 85,732,000 barrels, compared with 88,230,170 barrels in 1914, a decrease of 2.8 per cent; and the stocks of finished cement at the mills were about 11,583,000 barrels, compared with 12,893,863 barrels in 1914, a decrease of 10.2 per cent. The slight decrease in production and the considerable decrease in stock indicate greater caution in the industry, which in the preceding few years showed a tendency toward overproduction.

Increases in production in the Lehigh, Michigan and Northeastern Indiana, Iowa and Missouri, Southwestern, and two southeastern districts were offset by decreases in the other six districts.



Clean Streets in Philadelphia

A system of operating the street cleaning force of the city of Philadelphia has been worked out by the Bureau of Highways and Street Cleaning, of which William H. Connell is the head, which has materially increased the quantity of work done and improved its quality at the same time that the force employed has been slightly decreased. As it stands at present the street cleaning work is done under several systems, which are adapted strictly to the work to be done and the conditions on each individual street, and the number of cleanings per week is determined according to the traffic and the cleanliness as to their streets of the inhabitants of the various districts into what the city is divided. The various classes of work have been described by Mr. Connell in reports and papers about as follows:

Hand Patrol—The blockmen are assigned to sections designated by the chief of the Bureau of Highways and Street Cleaning, the area to be covered by each blockman depending upon the character and amount of traffic and ranging from 4,000 to 20,000 square yards per day. The duties of the blockmen consist of patrolling these areas, gathering all paper or other refuse, and sweeping street dirt as it accumulates and placing it in dustproof bags or metal cans, after which these bags or cans are collected and loaded into special wagons and hauled to a collection station or dump.

The equipment used in the hand patrol work consists of hand machines, bag carriers, burlap sacks, push brooms, pan scrapers, sprinkling cans and shovels. The dirt collected is placed in sacks and left at convenient points to be taken away by special wagons to the dump, the sacks being returned to the drivers. Sacks are generally used in preference to cans because of the weight, bulk and noisiness of the latter.

Machine Broom Cleaning—All machine broom cleaning is done in batteries of two or three, preceded by sprinklers, the number of brooms in each battery depending upon the width and character of the streets to be cleaned, the average gang consisting of two machine brooms, one sprinkler, four to seven gangmen, and a sufficient supply of carts or wagons to remove the sweepings, the number depending upon the length of haul to the dumps and the season of the year, together with the amount and character of traffic.

Squeegee Cleaning—Squeegee cleaning is used on smooth pavements. The operation consists of batteries of two and three squeegee machines preceded by sprinklers to soften and loosen the material on the streets, the sprinklers using as much water as possible without flooding the pavement; the squeegees using just enough water to create a wash. The idea of sprinkling in advance of the squeegees is to soften the dirt and enable the squeegees to cleanse the streets of all slime as well as the coarser materials. The squeegees are followed by two men, who immediately sweep up the windrows of dirt into piles, and a sufficient number of carts follow to remove the dirt from the streets. A photograph shows a gang of squeegee cleaners.

Flushing—Flushing machines are used only on the poorly paved streets and block pavements. The high-pressure flushing machines two of which are mounted on auto trucks, are usually operated singly, as most of the districts have but one flusher. A photograph shows the effect of the flusher on an old granite block street in removing the dirt between the stones as intended.

AUTOMOBILE FLUSHER, *Kinney type, on old granite block street. Note how well it washes out the joints between blocks, which in this case is the desired result.*

Alley Cleaning—All alleys and streets whose width between curbs is too narrow to permit the use of machine brooms, are cleaned once each week with a hose. When such streets or alleys are required by schedule to be cleaned more than once a week, the additional cleaning is done by hand brooms.

Hose Flushing—A hose flushing gang comprises a foreman and eight men, and operates in the heavy traffic business section of the city. The work is supplemental to the regular gang cleaning and to the blockmen cleaning and is done at night. The work is slow but thoro, the main object being to remove the fine dust and pavement detritus. Approximately 30,000 square yards can be cleaned in 10 hours by each gang.

A gang is equipped with hand brooms and 150 feet of hose with necessary attachments. One man operates the hose, the remaining men scrub the surface of the street, clean out the depressions and the gutters.

Inlet Cleaning—All inlets on paved streets and alleys are cleaned as often as necessary to keep them at all times free from obstructions, this work being done by special inlet gangs consisting of three men and a sufficient number of carts.

Country Road Cleaning—The cleaning of suburban and country streets and roads is taken care of by gangs, each consisting of one foreman, ten laborers and two carts. The work consists of pick-up cleaning, trimming the shoulders, opening and keeping the gutters clean, cleaning inlets, removing all refuse, rubbish and debris from the streets and such other work as may be necessary to keep the streets and roads in "spick-and-span" condition. The respective streets and roads are cleaned at least once every two weeks, and where necessary once or twice a week. The yardage of waterbound macadam, bituminous and concrete streets and roads, cleaned by the country road gangs is approximately 3,835,217 square yards.

The accompanying table shows the amount of work done in cleaning streets in 1915, per month, the percentages done by each method in use and the percentage of the total cost which the work done by each method bears to the total cost. It also gives the actual cost from the foremens' reports and the unit costs per 1,000 square yards cleaned and per cubic yard of dirt removed.

Of the methods used the hose flushing costs the most per

DEPARTMENT OF PUBLIC WORKS
BUREAU OF HIGHWAYS AND STREET CLEANING PHILADELPHIA PA.
STREET CLEANING COST DATA
MONTHLY STATEMENT
1915

CLASS OF WORK	SQUARE YARD CLEANED PER MONTH	CUBIC YARD OF DIRT REMOVED PER MONTH	PER CENT OF WORK	PER CENT OF COST	ACTUAL COST TOTAL COST FROM DISTRICT FOREMEN'S REPORT	ACTUAL COST UNIT COST TO CLEAN PER 1000 SQ. YDS.	ACTUAL COST UNIT COST PER CU. YD. DIRT	COST BY CONTRACT TOTAL COST MONTHLY SUM PAID BY CITY	COST BY CONTRACT UNIT COST TO CLEAN PER 1000 SQ. YD.	COST BY CONTRACT UNIT COST PER CU. YD DIRT
MACHINE BROOM	144424 000	22 372	62.3	42.9	39 462	.273	1.77	44 074	.305	1.97
SQUEEGEE	48 051 000	1 538	20.8	9.4	8 678	.170	5.65	9 657	.200	6.28
FLUSHER (HORSE)	8 044 000	"2	3.4	1.7	1 560	.194	—	1 746	.217	—
FLUSHER (AUTO)	"1 3 180 000	"2	1.4	0.8	780	.200	—	822	.258	—
ALLEY CLEANING	8 046 000	856	3.4	4.3	3 972	.494	4.64	4418	.550	5.16
HOSE FLUSHING	807 000	"2	0.4	0.4	397	.492	—	411	.510	—
ROADWORK	19 175 000	5 144	8.3	7.7	7 059	.368	1.37	7 911	.413	1.54
INLET CLEANING	"3	3 426	—	4.2	3 864	.018	1.13	4315	.020	1.26
BLOCKMEN	"4 147 993 000	7458	—	20.6	26 380	.178	3.54	29 383	.198	3.93
TOTALS	"4 231 727 000	40 794			92 152			102 737		
AVERAGE		0.177 CU YD PER 1000 SQ YD			"5 MACHINE WORK / HAND WORK	.248 / .392	2.10 / 1.84	MACHINE WORK / HAND WORK	.276 / .455	2.35 / 2.12

"1 AUTO FLUSHER COST IS BASED UPON 75,000 SY. CLEANING PER DAY PER FLUSHER AT A CHARGE OF $15.00 PER DAY (10 HR.) PER FLUSHER. FLUSHERS FINISH THEIR SCHEDULE AND HELP ON HORSE FLUSHER AND SQUEEGEE ROUTES

"2 DIRT REMOVED BY BLOCKMEN "3 APPROXIMATELY TWO INLETS PER 1000 SQ YDS.

"4 BLOCKMAN YARDAGE NOT INCLUDED IN TOTAL "5 HAND WORK DOES NOT INCLUDE INLET OR BLOCKMAN WORK.

NOTE: THE ABOVE COSTS INCLUDE THE COLLECTION AND DISPOSAL OF THE DIRT GATHERED, AND ARE BASED UPON RATE PER TEN HOUR PAID BY THE CONTRACTOR FOR LABOR AND EQUIPMENT. THESE RATES ARE AS LISTED BELOW.

BLOCKMAN WORK CONSISTS OF PICK-UP CLEANING AND IS ENTIRELY SUPPLEMENTAL TO MACHINE CLEANING.

WATER COST IS NOT INCLUDED IN THE ABOVE FIGURES. THIS COST @ 44¢ per 1000 GALLONS AMOUNTS TO $15,355.36 — 366,084,000 GALLONS BEING USED.

CLEANING AREA OF PAVED STREETS & COUNTRY ROADS — 1,408.2 Mi. — 21,240,318 SQ.YD.

COMPUTED ANNUAL COST — TOTAL $1,101,792 — PER MI. $782.35 — PER 1000 S.Y. $51.85

ANNUAL COST TO CITY BY CONTRACT $1,232,847 — " " " $875.55 — " " " $58.02

POPULATION (ESTIMATED 1915) 1,675,000 COST PER CAPITA — COMPUTED $0.658, CONTRACT $0.736

CONTRACTOR'S LABOR & EQUIPMENTS RATES USED IN ABOVE COMPUTATIONS

Superintendent	$4.00 per 10 hr. day	Dirt Cart - Driver & 1 Horse	$3.50 per 10 hr. day
Foreman	2.50 " " "	Sprinkler - " " 2 "	5.00 " " "
Ass't Foreman	2.00 " " "	Machine Broom - Driver & 2 Horses	5.50 " " "
Gang Laborers	1.75 " " "	Squeegee " " " "	6.00 " " "
Blockman	1.50 " " "	Flusher " " " "	7.50 " " "
Dirt Wagon - Driver & 2 Horses	5.00 " " "	Flusher (Auto) Chauffeur & Helper	15.00 " " "

THREE SQUEEGEE MACHINES *runing in a gang, preceded at some distance by a street sprinkler to soften up the dirt on the pavement.*

1,000 square yards, machine broom next, then auto flusher, horse-drawn flusher, blockmen and squeegee in the order named, the squeegee costing less than 40 per cent as much as hose flushing. This is true of both actual cost and cost by contract, except that blockmen and squeegee change places, the two costing very nearly the same in both cases.

Activated Sludge Experiments in Brooklyn, N. Y.

About a year ago we published an account of the experiments on sewage treatment in progress in a plant constructed for that purpose by the sewer department of the Brooklyn, New York City. Some of these experiments were based on the experimental work of the Massachusetts State Board of Health, which was the basis also of the experiments of Gilbert J. Fowler of England, which resulted in the particular process now bearing the name of activated sludge.

The process in principle is the same as that of the percolating filter, where the sewage drops slowly thru a mass of material with many voids in which aeration of the sewage and growth of aerobic bacteria take place which have the effect of breaking up the construction of the organic matter in the sewage and converting it into innocuous gases and sludge. The activated sludge process aerates the sewage directly and moves the activated sludge thru the liquid instead of moving the liquid thru the sludge resting on the particles of filter medium.

In a paper before the American Association for the Advancement of Science, George T. Hammond, who has charge of the Brooklyn experiments, describes his experiments during 1915, using the activated sludge process as developed by Mr. Fowler and a number of variations of it, to discover the maximum efficiency of the process, the range of variation practicable, the cost under various conditions, and the like. From these experiments, which are as yet far from completion, Mr. Hammond draws some preliminary conclusions and draws some inferences which he states are subject to modification when he has obtained further information from the results of his future work.

The work done so far does not seem to justify any very positive conclusions, while it does offer considerable promise. No conclusions adverse to the method have been reached, tho it does not as yet show any advantage in economy or reliability over other well-known methods, such as the Imhoff tank, followed by the percolating filter and settling tank.

Some of the problems that are engaging the attention of investigators are the effect of relatively low temperature in winter on the process; how the nitrogen in the sludge can best be built up; how much sludge will be formed under various conditions of operation, and whether a cycle or process of operation employing a series of tanks can be devised in such manner that all of the easily reducible organics will be removed from both sewage and sludge; how much sludge will be available for the manufacture of fertilizer, and whether all that is of value may not be required for use in the continuous flow plan of sewage treatment to diminish the time of aeration to a minimum.

There is probably a condition of equilibrium to be secured in the treatment under which just about so much sludge will be used by the process to obtain a required result, and just about such a surplus will have to be disposed of. How to adjust the method to the varying strength and quantity of the sewage as it flows to the plant, and the effect of varying strength of sewage on the expense of the treatment, also requires much study.

The efficiency of the method in regular service under the ordinary operation conditions that prevail in all American cities, its cost and economy, and its reliability as compared with other methods of sewage treatment now well known and giving good and cheap service, cannot but engage the careful study of conversative men, whose object usually is to provide the most economical method of treatment which shall offer the greatest promise of efficiency and reliability under existing requirements and circumstances.

Much remains to be learned of the new method along these lines; and while, to the scientist investigating it in the experimental plant it seems so promising, a word of caution should be given to the engineer charged at present with designing a sewage treatment plant. Judgment should remain suspended until more definite information is available on the points above mentioned.

Underground Water Resources of States Determined

The United States Geological Survey for a number of years has been prosecuting, largely in co-operation with the state surveys, a systematic study of the ground-water resources of all the Coastal Plain states. Reports have been issued, either by the Federal Survey or by co-operating state geological surveys, for Virginia, North Carolina, Georgia, Florida, Alabama, Mississippi, eastern Tennessee, Kentucky and southern Illinois, southeastern Missouri, southeastern Arkansas and Louisiana, northeastern Texas, the Black and Grand Prairie areas of Texas, and the area underlain by Tertiary formations in Texas south of the latitude of Jefferson and east of Brazos river. The manuscripts of papers on the ground-water resources of Delaware and Maryland, on the ground waters of northeastern Arkansas and on the ground waters of La Salle and McMullen counties, Texas, have been completed and will be published during the next fiscal year, and additional studies of the ground waters of Mississippi are in progress. Comprehensive studies of the ground-water resources of the Coastal Plain of Texas west of Brazos river are also approaching completion.

With good health recognized as one of the great national assets, the extent of this study of underground-water resources furnishes a measure of its value to the public. Reports have been published covering 376,000 square miles in the Atlantic and Gulf states, reports on 27,000 square miles are completed tho not yet published, field work has been completed on 50,000 square miles, and work is contemplated to cover 16,000 square miles. These areas of nearly half a million square miles include the parts of the United States in which impure water supplies involve the greatest danger. The value of such surveys in conserving public health has already been demonstrated, for it has been noted that wherever an adequate supply of deep-well water has been obtained, typhoid fever, amoebic dysentery and malaria have abated.

MISCELLANEOUS

The March of Events

Feb. 2-5, at Claypool Hotel, Indianapolis, Ind. The Indiana Sanitary and Water Supply Association meets, having joint sessions and banquet with the Indiana Engineering Society on Friday, Feb. 4. Dr. W. F. King, secretary, State House, Indianapolis.

Feb. 3-5, at Claypool Hotel, Indianapolis, Ind. The Indiana Engineering Society meets, those on the 4th being joint meetings with the Indiana Water Supply and Sanitary Association. Chas. Brossmann, secretary, Merchants Bank Building, Indianapolis.

Feb. 4-5, at Chicago, Ill. The American Electric Railway Association holds its seventh annual midyear meeting.

Feb. 9-11, at Columbus, O. The Ohio Engineering Society holds its annual meeting. John Laylin, secretary, Norwalk, O.

Feb. 10-11, at Engineering Societies Building, 29 West Thirty-ninth street, New York. The Illuminating Engineering Society will hold its midwinter convention, features of which will be a special presentation of an honorary membership to Thomas A. Edison at a banquet at the Biltmore, on the eve of his birthday.

Feb. 10-12, at St. Paul, Minn. The Minnesota Surveyors and Engineers Society will meet. At the dinner on the 11th Prof. F. H. Newell, of the University of Illinois, will be the principal speaker.

Feb. 12-19, at Coliseum and Armory, Chicago. The ninth annual cement show will be held. R. F. Hall, secretary, 208 North La Salle street.

Feb. 14, at Auditorium Hotel, Chicago, Ill. The Building Inspectors' Conference will be held. Rudolph P. Miller, chairman, 100 Morningside Drive, New York.

Feb. 14-17, at Chicago. The American Concrete Institute will meet. John M. Goodell, secretary, 1418 Walnut street, Philadelphia, Pa.

Feb. 15-18, at Chicago. The National Conference on Concrete Road Building will be held. J. P. Beck, secretary, 208 South La Salle street, Chicago, Ill.

Feb. 16-18, at Des Moines, Ia. The Iowa Engineering Society will meet. J. H. Dunlap, secretary, Iowa City, Ia.

Feb. 17-18, at Chicago. The American Concrete Pipe Association will meet. E. S. Hanson, secretary, 538 South Clark street, Chicago, Ill.

Feb. 21-22, at Hotel Statler, Cleveland, O. An important meeting of the National Paving Brick Manufacturers' Association will be held. Will P. Blair, secretary, B. L. E. Building, Cleveland, O.

Feb. 21-26, at Washington, D. C. The United States government departments will hold a "safety first" exhibit, and on Feb. 24 a conference of state mine inspectors will be held at the office of the Bureau of Mines.

Feb. 28-March 3, at Mechanical Hall, Pittsburg, Pa. The annual convention and road exhibit of the American Road Builders' Association will be held. E. L. Powers, secretary, 150 Nassau street, New York.

March 6-10, at Sohmer Park, Montreal, Que. The third Canadian and International Good Roads Congress will be held by the Dominion Good Roads Association. Geo. A. McNamee, secretary-treasurer, 909 New Birks Building, Montreal, P. Q.

May 8-10, at Waco, Tex. The Southwestern Water Works Association will hold its annual convention. E. L. Fulkerson, secretary, Waco, Tex.

May 10-17, at Indianapolis, Ind. The National Conference of Charities and Corrections will hold its annual conference.

June 15-16, at Cleveland, O. The Ohio Society of Mechanical, Steam and Electrical Engineers will hold its annual convention. Joseph L. Skeldon, president, Toledo, O.

Sept. 6-9, at Newark, N. J. The League of American Municipalities will hold its annual convention.

December. The American Highway Association has passed resolutions declining the invitation to hold joint sessions with the American Road Builders' Association in February and approving of the new American Association of State Highway Officials, which will hold its next convention in December, 1916.

Joint Cement Exhibit

An important part of the joint exhibit of the cement manufacturing companies at the Chicago Cement Show will be the road display. The United States Government road models, which were exhibited at the Panama-Pacific Exposition, will be a feature of the concrete road division which should prove interesting to road builders. Full-size pavement sections, built to show road inspectors and contractors the errors of construction to be avoided, will be well worthy of careful study.

One section of the joint exhibit will be devoted to good vs. bad concrete. A 2,000-pound testing machine and other laboratory apparatus will be used to show that graded materials are more economical and make better concrete than bank run aggregates.

Builders who visit the show to study equipment, however, will have ample opportunity to investigate the standard machines of the industry. More comprehensive displays of equipment are possible because of the greater amount of display space which the Armory offers. Concrete mixers, block and brick machines, engines, pumps, hoists, crushers, forms for monolithic concrete, machines for sewer pipe and drain tile, road-building and contractors' equipment will be shown in greater number and variety than last year.

Technical Association Notes

The American Association of Enginers will issue to its members a monthly called *The Monad*, devoted to the objects of the association, "to raise the standing of ethics of the engineering profession and to promote the economic and social welfare of engineers."

At its meeting on January 13, the Brooklyn Enginers' Club heard a paper by A. W. Dow on preservative oils for the treatment of wood paving blocks.

Technical Schools

The Municipal University of Akron, O., makes a specialty in its technical work of co-operation with machine shops, railroads, contractors and builders and the municipality, whereby students accompany their academic work with practical experience, beginning at the bottom, as section hands on a railroad, for example, amplifying to some extent the plan which has been in operation at the University of Cincinnati for some years. Fred E. Ayer is the dean of the College of Engineering.

Robert M. Raymond has been appointed professor of mining in the Columbia University Graduate School of Mines, succeeding Prof. H. S. Munroe, who retired last June, after thirty-seven years of service in the position.

Five research fellowships, each of $500 a year for two years, will be vacant in the Engineering Experiment Station of the University of Illinois at the close of the present school year, and nominations will be made in February. Those interested should communicate with the director of the Engineering Experiment Station, Urbana, Ill.

The Massachusetts Institute of Technology has made arrangements to test the samples of materials to be used in the construction of the new dry dock under Edward F. McSweeney, chairman of the directors of the port. The Institute is aiding another state department, the Fire Prevention Commissioner, in determining the flash points of inflammable fluids. These are indications of the desire of the Institute to place its facilities at the disposal of the public as represented by departments in the government.

The short course in highway engineering at the University of Illinois, January 10 to 21, was a little longer than some of those held by the state universities and included in its program many experts, including Dr. Newell, head of the civil engineering department; W. S. Gearhart, state engineer of Kansas; W. W. Marr, H. E. Bilger, B. H. Pirepmeier, Clifford Older, F. L. Roman, S. E. Bradt, A. D. Gash and James P. Wilson, of the Illinois State Highway Department; A. R. Hirst, state highway engineer of Wisconsin; T. H. MacDonald, state highway engineer of Iowa; Dr. L. I. Hewes, of the U. S. Office of Public Roads; several members of the university and other university faculties, several county highway superintendents and such experts in highway materials as W. P. Blackwood, of the Barber Asphalt Paving Co.; James A. Cannon, of the National Refining Co.; A. L. Kuehn, of the American Creosoting Co.; Philip P. Sharples, of the Barrett Manufacturing Co.; C. M. Powell, of the Universal Portland Cement Co.; Prof. C. C. Wiley, instructor in highway engineering, and Prof. N. B. Garber, instructor in bridge engineering, held two-hour sessions each day with each of two sections for detailed instruction in highway and bridge design, construction, maintenance and repair, the nine days allowing a very satisfactory detail in the programs. Altogether, the program was one of the most elaborate and satisfactory yet presented by a road school not limited to college graduates.

The good roads schools this winter include one at Purdue University, Lafayette, Ind., under the direction of the School of Civil Engineering. The University of North Carolina will have a good roads institute in the month of February. Cornell University will devote a week to good roads instruction February 14-19. The University of Tennessee, at Knoxville, has provided for a short course in highway engineering. The University of Illinois held a similar course in January. The University of Michigan will do likewise February 21-25. The University of West Virginia has just completed its third annual session in the School of Good Roads. A post-graduate course in good roads is now being given at the Iowa State College, January 3 to February 26. A special course, under the direction of the highway department of the College of Civil Engineering for the education of county road officials, will be given in February at the State University of Kentucky at Lexington. Illustrated lectures on highway construction have been one of the special features of the work at Columbia University, New York, during the winter. A special course in road building and maintenance has recently been concluded at the Maryland Agricultural College. The University of Pittsburgh holds one January 31-February 5, and the Wisconsin Highway Commission on the same dates.

Will This Meet a Poet's Eye?

The Committee of One Hundred on the 250th anniversary of the founding of Newark, N. J., offers thirteen prizes of $50 to $250 each in gold for the most acceptable poems on subjects related to the anniversary, to be in the hands of the editor of *The Newarker*, Committee of One Hundred, Newark, N. J., on April 10, 1916, from whom full particulars can be obtained.

The City Manager in Johnson City, Tenn.

Wm. R. Porter, who is one of the governing body of Johnson City, Tenn., has written a defense of the city manager plan as compared with the commission plan of government, showing the experience in that city, the amendment which is needed to perfect its system and the defects in the commission form as it is proposed to apply it in that city. From his article some of the statements are abstracted as follows:

In 1909 an amendment to the charter of Johnson City, Tenn., was secured authorizing the employment of a city manager. The city ordinances designated him "The City Commissioner," until recently. We have had three combination managers and engineers in that time. For several years we have had 75 per cent. of the benefits of this city manager plan. All we now need to enable the city to embrace all the benefits of the plan, is one simple charter amendment, and a broader conception of the functions of a city manager. The amendment should limit the activities of the governing body to legislating; selecting a manager, and seeing that he manages properly or makes room immediately for one who will. It does not matter whether this governing body be called Board of Mayor and Aldermen or Board of Commissioners. What does count is that the number of its members is kept large enough to make it a representative body and make corruption of the government difficult; and that its powers and the manager's powers are defined and limited with exactness in the charter amendment. It would not be necessary to change otherwise a charter which has stood the test of time, and was prepared with great care to fit this one city.

Government by a small commission puts all a city's interests in peril, sooner or later. Opposition to that form is based on questions of economy, effectiveness and safety of the public's interests. Of those cities now working under the city manager plan, a large number first tried out this commission plan, and discarded it. Look at some of our own Tennessee cities. The courts are ousting city commissioners right along for crookedness in office. How does this happen under a form of government which is reputed to cure all the ills of a municipality, according to local agitators? Just this: this commission system puts into the hands of a small clique—three or

five men—the absolute control of all legislation and the intimate direction of the business of the city, with no restraining influence above them except that bit of deceptive bait, recall by the voters. A few representatives of the outraged public had to get the courts to oust the delinquent commissioners.

Galveston's New City Hall

Galveston, Texas, is just completing a new city hall and auditorium at a total cost, including site, of $320,000. The city offices occupy a four-story building at one end of the group, the fourth story being allowed for future growth, as the officers just moving in will all be accommodated in the lower three stories. The auditorium is completed and is now in process of furnishing. It has a capacity of 5,000 persons with seats provided for 4,000, a stage, movable floor and two balconies. Ramps are used instead of stairways. The auditorium will be open for conventions, for which Galveston has heretofore provided no special facilities, and can be used for any form of entertainment.

Commission Government in Birmingham, Ala.

Birmingham, Ala., has been operating for some years under three commissioners according to the usual form of commission government, but last September the voters authorized a change of the number of commissioners to five. Geo. B. Ward, who has been mayor and commissioner for some time and was formerly mayor of the city under the mayor and council system, becomes president of the new board of commissioners, head of the department of finance and president of the board of education. The other commissioners will have charge of the departments of public justice, including police and recorder's courts, streets and highways, public health, sanitation and education, and public buildings and public utilities.

Motor Trucks in Business

In 1910, there were less than 10,000 motor trucks in use in the United States. It is conservatively estimated that today there are 100,000.

Every business that gives delivery or haulage service must use motor trucks nowadays in order to keep up with competition. The obvious arguments for trucks are these:

1. That they cover more ground than horses.
2. That they make possible a greater radius of delivery—hence patronage.
3. That they are more reliable.
4. That, if kept busy, they are cheaper.
5. That they are a good advertisement.

Blasting a Ditch

James T. Myers, of Callam Bay, Wash., blasted a ditch 3,270 feet long and averaging 2 feet, 10 inches deep, with dynamite in 17 days without help, reclaiming a number of acres of land. It carries off the water formerly flooding the land and has required no shoveling out of caved sides of the ditch since it went into operation.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

February 2—Physical laboratorian at Naval Proving Ground, Indian Head, Md., at $3.84 a day.

February 2, 3—Surveyor in Engineer Department at Large, War Department, at $90 to $150 a month.

February 15—Topographic and sub-surface draftsman in Navy Yard, Philadelphia, Pa., at $4.48 to $5.04 a day; master mechanic in Frankfort Arsenal, War Department, Philadelphia, Pa., at $2,400 a year.

March 15—Aid, Bureau of Standards; aid, Coast and Geodetic Survey; computer, Coast and Geodetic Survey; draftsmen, copyist topographic and topographic in Departmental Service, Engineer Department at Large; marine engine and boiler and ship in Navy Department; forest assistant in Forest Service; junior engineer, mechanical or electrical, Engineer Department at Large.

April 12—Assistant observer, Weather Bureau; civil engineer and draftsman, Departmental Service; computer, Nautical Almanac Office and Naval Observatory; computer and estimator, Supervising Architect's Office; draftsmen, architectural, in Supervising Architect's Office, topographic and mechanical in Panama Canal Service; junior chemist, Departmental Service; junior civil engineer, Engineer Department at Large; laboratory assistant, Departmental Service.

Personal Notes

Frank C. Perkins, M. E., of Buffalo, N. Y., proposes a state or municipal hydro-electric power plant to utilize the 4,400 second-feet of water which can still be drawn by the United States from Niagara river above the falls, under the treaty with Canada. He would also utilize 600 second-feet used to dilute the sewage of the city of Niagara Falls, which now goes to waste.

Thomas D. Lindsay has been appointed superintendent of public works for Ansonia, Conn.

Richard B. Williams, Jr., is the new commissioner of public works of Syracuse, N. Y., and Henry C. Allen returns as city engineer after two years' vacation.

Paul E. Mercier, who has been acting city engineer of Montreal, Que., has been appointed chief engineer of public works of that city.

Clarence W. Marsh, recently director for the Hooker Electro-chemical Co. and others, has established an office as an independent consulting and chemical engineer in the Boston Safe Deposit and Trust Co. building, 201 Devonshire street, Boston, Mass. He mentions specially the manufacture of electrolytic caustic soda, bleach and chlorine products among the subjects in chemical and allied industries in which he can render service as investigator, advisor and organizer.

Ray S. Blinn, who has been city engineer of Mt. Vernon for several years, has been elected city manager of Westerville, Ohio, under the new commission charter, at a salary of $1,500 a year.

Clarence W. Hubbell has opened an office at 2334 Dime building, Detroit, Mich., for practice in consultation, design and supervision of construction in sewerage, sewage disposal, water supply and municipal engineering, with three associates in civil, mechanical, sanitary, chemical and bacteriological lines. Mr. Hubbell's experience includes several years in charge of the engineering department of the Detroit water works and in municipal engineering in Manila and the Philippine Islands.

Clifford Older, bridge engineer for the Illinois State Highway Commission, has been elected president of the Engineers' Club of Springfield, Ill., now two years old, and with a membership of 130. The club meets the second Monday night of each month.

F. W. Ballard, of the Cleveland municipal lighting plant, has opened offices in the Swetland building, Cleveland, Ohio, for the practice of engineering and architecture under the title of F. W. Ballard & Co. He publishes a bulletin on some essentials of ornamental street lighting, the first of a series which together will describe the Cleveland municipal lighting plant, its construction and operation.

Blaine S. Smith, general sales manager of the Universal

Portland Cement Co., has been elected general secretary of the Chicago Association of Commerce.

Robert N. Kinnaird, chief engineer of the Des Moines Water Co., is president of the Iowa section of the American Water Works Association.

Lindell Theodore Bates has opened an office at 71 Broadway, New York, for the practice of law, with special regard to French, Spanish and South American affairs.

George H. Norton now has the title of city engineer, Department of Public Works, Buffalo, N. Y., a promotion to which his excellent service for the city fully entitles him.

Mayor Smith of Philadelphia has appointed the official family for the administration upon which he has just entered, and it includes George S. Webster, director of wharves, docks and ferries, who has long been an efficient employe of the city in various capacities; Joseph H. MacLaughlin, director of supplies; William H. Wilson, director of public safety; Dr. Wilmer Krusen, director of public health and charities, and George E. Datesman, director of public works, all new faces in their departments.

Carl C. Widener, Bozeman, Mont., was elected president of the Montana Institute of Municipal Engineers, which held a very successful three-day convention at Billings, January 17-19. The society practically covers its field with its thirty-four members.

Miles C. Riley and Howard F. Ohm have opened an office in the Washington building, Madison, Wis., for the practice of law, paying special atteution to drafting and codification of national and state laws, compilation, analysis and annotation of court and commission decisions, both of them having had some years of experience of special value to them for this class of work.

Frederic H. Fay, chairman of the committee on municipal and metropolitan affairs of the Boston Chamber of Commerce, and a member of the firm of Fay, Spofford & Thorndike, consulting engineers of Boston, gave an illustrated paper on "The Boston Metropolitan District" before the Detroit Engineering Society on Friday evening, January 21. Representatives of the Detroit Board of Commerce attended the meeting. Mr. Fay laid emphasis on the duty of engineers to give themselves to some extent to public service, because so many of the problems of a municipality are of an engineering character. He outlined the work of the committee, of which he is chairman, as displayed in its constructive interest in the larger municipal problems of Boston, in keeping watch of legislation, reporting on public improvements, offering suggestions regarding the solution of important problems and aiding, with the prestige of the chamber, in putting thru measures which appear to be for the public good.

W. Mont Ferry is mayor of Salt Lake City and commissioner of public safety under the new commission which has just taken office. Two of the five members are holdovers, and the other three are experienced in city affairs as officeholders. Mayor Ferry having been for years a member of the old city council and its president.

Publications Received

F. W. Ballard has reprinted in convenient form the most important points made in his paper before the conference on valuation held under the auspices of the Utilities Bureau in Philadelphia, in November, 1915, upon "Some Essentials of Appraisal Work."

Bulletin 314 of the U. S. Department of Agriculture is a professional paper from the office of Public Roads and Rural Engineering by Prevost Hubbard, chemical engineer, and Charles S. Reeve, chemist, which brings down to date the methods for the examination of bituminous road materials in use by the department, describing in detail the pieces of apparatus and the methods of using them.

"Laboratory Tests of a Consolidation Locomotive," by E. C. Schmidt, J. M. Snodgrass, and R. B. Keller has been issued as Bulletin No. 82 of the Engineering Experiment Station of the University of Illinois. The tests whose results are recorded constituted the first work done in the recently established locomotive laboratory of the University of Illinois and relate to a typical consolidation locomotive.

"Principal and Practice of Cost Accounting" is a treatise on the subject of manufacturing costs designed to meet the needs of accountants, manufacturers, mechanical engineers, teachers and students, written and published by Frederick H. Baugh, P. O. Box 682, Baltimore, which has for its object a comprehensive and practical presentation of the general principles upon which cost accounting for manufactured articles is based, the application of these principles and the illustration of details. 180 pp. $3.

First annual report of the Iowa State Highway Commission, from April 9, 1913, to December 1, 1914. Thos. H. MacDonald, state highway engineer, Ames, Iowa.

Twenty-eighth annual report of the Street and Sewer Department of Wilmington, Del., A. J. Taylor, chief engineer.

The Cleveland, Ohio, municipal lighting plant is fully described, particularly as to investment costs, engineering features and operation costs, in Bulletin No. 2, issued by the Department of Public Utilities, Division of Light and Heat, by F. W. Ballard, commissioner and chief engineer. It fully answers all criticisms which have been made of the plant and shows that the plant is profitable, altho the rates charged for its service are much lower than those formerly charged by the private company serving the territory before the municipal plant was built.

The eighth annual report of Pasadena, California, Municipal Lighting Works Department, by C. W. Koiner, general manager and electrical engineer, shows the pronounced success of this municipally owned and operated plant under continuous expert technical and financial management, which was subjected in its earlier history to the same kind of attacks now made on the Cleveland lighting plant and has fully demonstrated that the attacks were wholly unwarranted.

Annual Report of the Board of Street and Water Commissioners of Newark, N. J., for 1914, Morris R. Sherrerd, chief engineer, Department of Public Works.

Forty-eighth annual report of the Commissioners of Water Works, Erie, Pa., for 1914. Geo. C. Gensheimer, secretary and treasurer.

Technologic Paper No. 44 of the U. S. Bureau of Standards is a preliminary report of an investigation of the durability of cement drain tile in alkali soils and shows that rich concrete and very careful construction are necessary in strong alkali soils.

Sixteenth annual report of the Water and Light Department of Duluth, Minn. D. A. Reed, manager.

State highway mileage and expenditures to January 1, 1915, are the subjects of Circular No. 52 of the U. S. Department of Agriculture, prepared by the division of road economics, Office of Public Roads and Rural Engineering.

The annual report of the city engineer of Moline, Ill., Lyle Payton, is in pocket-book size, but is full of statistical information of value, including water, sewer and paving maps.

Invincible America, a plan of constructive defense, is the subject of a pamphlet by Harry G. Trave, of New York, in which he proposes a military organization for the men engaged in national improvements and the extension of construction by the U. S. Government to roads, as a measure of defense as well as of service to the people.

"Methods of Washing Slow Sand Filters," by John Gaub, chemical engineer of the filter plant at Washington, D. C., describes and illustrates the methods in use, and will be sent by Mr. Gaub on request.

MACHINERY AND SUPPLIES

Atlantic Electric Trucks

A recent important development in motor transportation is the electric truck which is now furnished by the Atlantic Electric Vehicle Company, of Newark, N. J., in four sizes, with capacities of 1, 2, 3½ and 5 tons, respectively. The claims of advantage for the electric truck are cleanliness, no odors or smoke, lessened fire danger to vehicles or load, less insurance on garage, all points in favor of the motive power used; no noise, ease of starting and control, excessive speed impossible, less space needed at loading platform, shipping shed or in garage, and maximum carrying space for wheel base.

The saving by using mechanical haulage is from 15 to 50 per cent. of the cost of hauling with horse and wagon, the amount of saving depending on character of loads, time required to handle them, average haul per load, hours of work and number of miles a day and grades on the roads traveled, but the saving is always positive with reasonable management.

The designs of the Atlantic electric trucks follow standardized practice as to proportion and size of parts, quality of material and workmanship, so that there is no experimenting done at the expense of purchasers. Moreover, the duty of the company does not end with the sale of its vehicles, but they have a complete service department to aid in the proper care and upkeep of their vehicles. The specifications for all parts show the highest quality of materials and workmanship.

As to the parts special to electric vehicles: The batteries may be either Exide batteries of the lead-plate type, with acid electrolyte, or Edison batteries of the nickel-iron-plate type, with alkaline electrolyte. They are suspended in cradles beneath the frame and can be unloaded from either side.

The battery charging equipment furnished is determined by the kind of current available to the purchaser; with alternating current a mercury arc rectifier for a small number of trucks or a motor generator set for a larger number; with direct current a charging panel adapted to the voltage of the current. Appliances for high-rate charging can also be supplied if desired.

The illustration herewith shows a 5-ton truck for delivering building materials and gives an idea of the substantial design and construction of the truck, chassis and body and the attention paid not only to strength and durability, but to ease and convenience of handling.

M. & W. Oil Engines

Although a product of some twenty years standing in the engineering field, the M. & W. oil engine embodies several novel principles which have only recently begun to be established on the plane of standard practice. Two decades have thus vindicated the wisdom of the designers who have produced an engine which will operate successfully on kerosene, crude oil, fuel oil, alcohol or distillate, yet is totally without carbureting apparatus, so-called mixing valves or electrical ignition devices.

This engine is of the two-stroke cycle type, in which the preliminary air compression for scavenging takes place in the crank case. Air compressed in the crank case by the downward movement of the piston is at the proper moment admitted to the compression space above the piston by means of the usual by-pass found in engines of the two-stroke cycle type. Compression of the air in the combustion space due to the upward movement of the piston raises the temperature to within a very few degrees of the ignition point of the fuel which is at the proper moment sprayed into the cylinder and against the projecting lip of an "ignition ball" which, after preliminary heating by a blow-torch, maintains its temperature at or above the ignition point due to combustion temperature in the cylinder.

Since the fuel is sprayed directly into the combustion chamber shortly before completion of the compression stroke, there can manifestly be no loss of fuel thru crank-case leakage or thru exhaust ports, neither is the supply of lubricating oil in the crank case subject to deterioration because of dilution with the liquid fuel, as is the case in all types of two-stroke engines which compress a carbureted fuel mixture in the crank case. M. & W. oil engines are built in the horizontal stationary type in sizes from 2 to 300 h.p.; in the vertical stationary type in sizes from 2 to 400 h.p.; and in the vertical marine type in sizes from 2 to 600 h.p., the latter in sizes from 45 to 600 h.p., being in themselves directly reversible and requiring no reversing gear whatever.

A large number of M. & W. oil engines have recently been installed, among the purchasers being the following:

Melchior, Armstrong & Dessau, New York City, 30 and 40-h.p.

Wayne Cold Storage Company, East Williamson, N. Y., 80-h.p.

Dill Machine Company, Philadelphia, Pa., 50-h.p.

American Steamship Line, New York City, two 35-h.p. direct connected generator sets.

American Mineral Company, Johnson, Vt., 100-h.p. This plant also has an 80-h.p. engine in operation.

Atlantic Fruit Company, New York City, 12-h.p. generator set. This concern has several Mietz & Weiss oil engines in operation.

Pennsylvania Railroad Company, Altoona, Pa., eight 40-h.p. engines direct connected to generators.

Shipley Construction & Supply Co., Brooklyn, N. Y., three 50-h.p. single cylinder horizontal engines.

Baer Bros., Stamford, Conn., one 150-h.p., making the second unit of this size in this plant.

McCreery Machinery Company, Seattle, Wash., two 150-h.p. Mietz & Weiss direct reversible marine oil engines.

Swayne & Hoyt, San Francisco, Cal., one 200-h.p. Mietz & Weiss direct reversible marine oil engine.

Harding Creamery Company, Omaha, Neb., one 150-h.p.

Hind Steel & Wire Works, Huntington, L. I., 50-h.p., making two of these units in this plant.

American Trading Company, New York City, one 30-h.p.

Albert R. Reynolds, Silver Lake, N. H., 50-h.p.

These engines took the medal of honor, one of the highest awards offered at the Panama-Pacific International Exposition. They are well-known all over the world, and are in extensive use by the United States and foreign governments, as well as by private interests in all classes of service.

Auto Truck Snow Plow

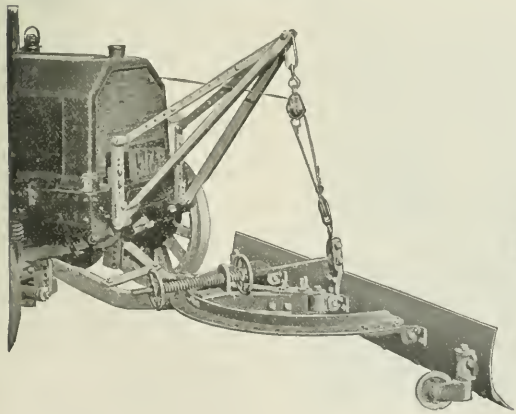
We are illustrating a type of front truck snow plow, such as has been successfully tried out by the city of Chicago, with the result that they have ordered two or more front and one rear plows.

The front plow blade is hinged to supporting circle, so when any obstruction is encountered it trips and prevents damage to plow or truck. Heavy springs restore blade to working position when obstacle is passed. Hand wheels adjust tension of springs. Blade is easily lifted by rope from seat of truck.

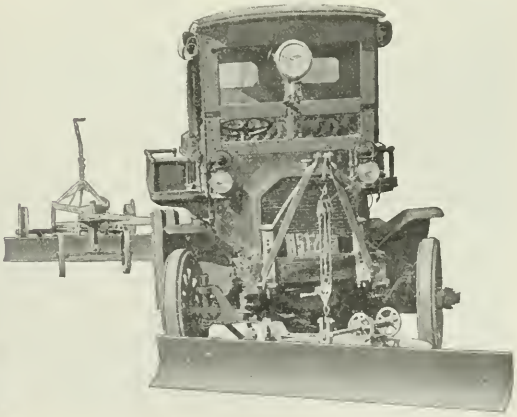
The blades may be set both same way or in opposite directions, thus throwing the snow to one or both sides. Blades are reversible and can be set at any angle desired. Weight of front plow, 550 lbs.; rear plow, 1,300 lbs.

The rear plow has offset hitch. Thus the furrow thrown by front plow is taken up by rear and moved over another six feet. Blade of both front and rear plow is carried on adjustable casters or set firmly on pavement as desired. Blade of rear plow is easily controlled by lever from platform. Flanged rear wheels effectually prevent skidding.

This type of plow, which is made by The Baker Mfg. Co., Springfield, Ill., may be attached to any standard auto truck. Blades are eight feet long. Each plow (front and rear) cleans a space six feet wide as rapidly as the truck travels. Thus at one operation a path twelve feet wide is cleaned at a speed of twelve to fifteen miles per hour.



REAR VIEW OF FRONT PLOW.



ARRANGEMENT OF BOTH FRONT AND REAR PLOWS.

Dustless Refuse Collection

The Mesco sanitary refuse collection vehicle is designed to provide a sanitary system of odorless and dustless ash and garbage collection and to minimize the strain put upon the workmen in the ordinary collection of such refuse. No special can is required for this system. The ordinary can in general use and sanitary cans of various types and widths can be used in conjunction therewith.

When loading, the operator by means of an endless chain simultaneously raises the hoisting crane and at his option places in position the right or left monorail and roller conveyor, together with the running board underneath. The loaded cans are then clipped to the steel cable pulley tackle and raised by means of motor power to the roller conveyor, and guided to the closed hopper mouth. Tipping the can causes its weight to open the hopper and its contents to be deposited into the body of the truck, while the removal of the can automatically closes the hopper mouth. During the operation of emptying, the tapering hopper has provided a sealed connection, preventing dust or offensive odors escaping into the atmosphere.

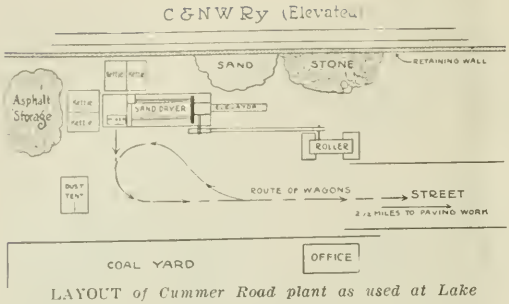
The Packard hydraulic hoist used to dump the vehicle consists of a hydraulic cylinder using ordinary gas engine oil. The actuation is by an oil pump attached to the base of the cylinder.

Power for driving the geared pump is taken from the propeller shaft or from a special Packard power drive mechanism directly attached to the transmission. The entire pumping apparatus can be controlled by the driver without leaving his seat. This hoist will elevate a 6-ton load to a 55-degree angle in 20 seconds, and the body will return to its lowered position in 12 seconds. The angle of 55 degrees secures clean scavenging.

The machines, whether hand or automobile, are sold by M. Eberhart & Son Co., 76th street at First avenue, New York.

750 Yard Asphalt Plant Turns Out 1,200 Yards of Asphaltic Concrete per Nine-Hour Day

An average of over 1,200 square yards of 2-inch asphaltic concrete pavement per nine-hour day was the record made by



LAYOUT *of Cummer Road plant as used at Lake Forest, Ill.*

Contractor H. G. Goelitz, Oak Park, Ill., on a contract for paving five streets in Lake Forest, Ill., using a Cummer 3-unit, 750-yard capacity road plant. This record is especially noteworthy on account of the unusually wet weather conditions which prevailed and which made it impossible to run the plant continuously. In spite of the speed at which the work was carried on, the asphaltic concrete, according to those in charge of the work, was of good quality. The sand and stone, usually wet when entering the drum, were turned out thoroly dry and heated to the required temperature of 325-340 degrees, and the mixer performed equally good service in producing a uniform and highly satisfactory concrete.

The yardages of the various streets were as follows:

Spring Lane	1,342.4 sq. yds.
Mayflower Road	8,036.3 sq. yds.
Lake and Hawthorne	4,791.0 sq. yds.
C. H. McCormick driveway	1,185.0 sq. yds.
Total	15,404.7 sq. yds.

The C. H. McCormick driveway, as indicated by the name, is a private street, and the paving was paid for by the owner, altho the work was done simultaneously with the city streets.

All the streets are located in the residential district of Lake Forest, but the locality is so sparsely settled that they partake somewhat more of the nature of roads than streets, and the pavements were made only 18 feet wide. The old pavements were of macadam, somewhat rutted and with numerous pot holes in the surface. Owing to light traffic it was thought unnecessary to put in concrete foundations, and the asphaltic concrete was laid directly over the old macadam after the latter had been scarified, brought to the proper grade and thoroly rolled. Concrete combined curb and gutters were put in on each side.

The asphalt plant was located near a coal yard along the Chicago & Northwestern railroad, near the northern limits of the village, enabling all materials, sand, stone, asphalt and coal, to be readily assembled. The sketch shown on this page gives a good idea of the layout of the plant. Cars of asphalt (in barrels), sand and stone were "spotted" on a railway siding opposite the plant, the materials being unloaded by hand to the positions shown. The sand and stone were wheeled from the piles to the elevator in barrows.

A 10-ton tandem steam roller furnished the power to drive the machinery of the asphalt plant, being connected by belt.

Four asphalt kettles placed as shown on the diagram, adjacent to the mixer, were kept in continuous operation. The heated asphalt was dipped out of the kettles into the weighing apparatus above the mixer.

Aggregates consisted of crushed limestone ranging in size from ½-inch down, lake sand and limestone dust, the last named material coming in sacks and being stored in the tent shown on the diagram. One mixer batch was made up by weight, as follows:

Asphaltic cement	55 lbs.
Limestone dust	55 lbs.
Aggregates	590 lbs.
Total	700 lbs.

With a haul of about 2½ miles from the plant to the job, six wagons were necessary to transport the asphaltic concrete as fast as the plant turned it out. The average time necessary for the round trip was 1¼ hours.

Seventeen men, including the foreman, were found to be the most economical crew for operating the plant. The crew was made up as follows: One foreman, one mixerman, one drum fireman, one weighman, one dustman, one dipperman, one kettleman, one engineer and nine laborers; total, 17 men.

The work of the nine laborers comprised unloading of cars, wheeling sand and stone, stripping asphalt and loading kettles.

The asphalt plant was put in operation on this work on October 28, 1915, and turned out the last batch on December 8, 1915, making a little over a month's work. Records show that for producing 14,062.3 square yards of asphaltic concrete for the Mayflower, Lake and Hawthorne roads and the C. H. McCormick driveway, the plant was running only 117 hours. During that time it turned out a computed amount of 16,044 square yards, i. e., the contractor made the asphaltic concrete

PHOTOGRAPH OF CUMMER ROAD PLANT IN OPERATION AT LAKE FOREST, ILL.

somewhat thicker than 2 inches in place on the street. Dividing the computed yardage by the number of hours the plant was at work gives 137.1 yards mixed per hour, or 1,233.9 yards per nine-hour day, certainly a good record for a road plant rated at only 750 yards per ten-hour day.

Owing to the excessive rains and poor transportation facilities, the maximum number of hours worked on any individual day was seven hours, and the maximum yardage produced in one of these seven-hour days was 1,229 square yards.

The asphaltic concrete mixture called for in the specifications was as follows:

Bitumen	6½	to 8	per cent.
Mineral passing 200 mesh	6	to 10	per cent.
Mineral passing 80 mesh	6	to 15	per cent.
Mineral passing 40 mesh	10	to 25	per cent.
Mineral passing 10 mesh	10	to 20	per cent.
Mineral passing ¼ mesh	10	to 20	per cent.
Mineral passing ½ mesh	5	to 20	per cent.

The asphalt plant was not a new one and had established a good record for itself the previous year in Evanston, Ill. The streets paved in this city were as follows:

	Sq. Yds.
South street boulevard—	
Sheridan road to Chicago avenue	5,989
Ridge road to Northwestern elevated	4,623
Sheridan road—	
South boulevard to Main street	12,000
Forest avenue—	
Main street to Greenwood	4,830
Total	27,442

Work on this system of roads was begun on September 19, 1914, and finished on October 31, having worked parts of twenty-nine days and about twenty-five full days of nine hours each.

The computed yardage turned out in this time was 27,115, or 1,085 yards per day of nine hours. The maximum day's run was 1,415 yards, nearly double the rated capacity of the plant.

Owing to the fact that the traffic on the Evanston streets, particularly Sheridan road, a much-used automobile thorofare, is much heavier than on those in Lake Forest, a greater percentage of stone was used in the asphaltic concrete mix. An average mix was about as follows:

Bitumen	7 per cent.
Mineral passing 200 mesh	9 per cent.
Mineral passing 80 mesh	10 per cent.
Mineral passing 40 mesh	19 per cent.
Mineral passing 10 mesh	15 per cent.
Mineral passing ¼ mesh	15 per cent.
Mineral passing ½ mesh	25 per cent.
	100 per cent.

The kinds of aggregates were about the same as those used in Lake Forest. One mixer batch was made up by weight as follows:

Asphaltic cement	44 lbs.
Limestone dust	80 lbs.
Aggregate	575 lbs.
Total	699 lbs.

The layout of the plant was much the same as at Lake Forest, being located on the west branch of the Chicago & Northwestern railroad, about two miles from the job. The make-up of the plant crew and the method of handling aggregates were the same. The streets were paved somewhat wider than those in Lake Forest, some having a macadam base and others a concrete base. They are all giving excellent service.

Those in charge of the engineering part of the Lake Forest work were James Anderson, Jr., city engineer of Lake Forest, and Lester Kirschbraun, consulting chemist, Chicago, Ill. Wililam Long is city engineer of Evanston, and Lester Kirschbraun was also consulting chemist in this work.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, 881 Bond Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,162,790. Prepared mortar. Clyde M. Long, Toledo, O., assignor of one-half to John M. Losgar, same place.

1,163,058. Sewage-treatment plant. Thomas J. Belfranci, Oroville, Cal., assignor of one-half to Marie C. Belfranci, same place.

1,163,050. Artificial stone. Grosvenor Atterbury, New York, N. Y.

1,163,087. Fire extinguisher. Augie L. Hansen, Chicago, Ill., assignor to Justrite Mfg. Co., same place.

1,163,096. Tunnel construction. Duncan D. McBean, New York, N. Y.

1,163,176. Locking device for hoisting apparatus. William Rutan, New York, N. Y., assignor to Gillis & Geoghegan, New York, N. Y.

1,163,169. Brake mechanism for hoisting apparatus. Edward Pavelka, New York, N. Y., assignor to Gillis & Geoghegan, same place.

1,163,189. Manhole and cover for the same. John S. Wolf, Yonkers, N. Y.

1,163,321. Electrical water-purifying appliance. Has Clark, Kansas City, Mo., assignor of two-thirds to John R. Green, Oklahoma, Okla., and Thomas T. Bathurst, Kansas City, Mo.

1,163,334. Water filter. Arthur L. Gammage, Everett, Mass.

1,163,355. Cap for hose connections. Jonathan C. Meloon, Providence, R. I., assignor to General Fire Extinguisher Co.

1,163,375. Form for concrete. James R. Selfridge, San Francisco, Cal., assignor to Selfridge Holding Co., same place.

1,163,376. Form for concrete. James R. Selfridge, San Francisco, Cal., assignor to Selfridge Holding Co., same place.

1,163,377. Concrete-pile form. James R. Selfridge, San Francisco, Cal., assignor to Selfridge Holding Co., same place.

1,163,480. Mold for building poured concrete structures. Lyman C. Stewart and Marshall A. Quinn, Roanoke, Va.

1,163,497. Extension boom. Nils E. Anderson, Miami, Fla.

1,163,593. Manufacture of asphalt cement from natural asphalts. Charles N. Forrest, Rahway, N. J., assignor to The Barber Asphalt Paving Co., Philadelphia, Pa.

1,163,624. Sewer cleaner. William J. Stevenson, Philip A. Fuchs and William Hiecke, Jr., Milwaukee, Wis.; said Fuchs assignor of one-twelfth of the whole right and said Hiecke of one-twelfth of the whole right to said Stevenson.

1,163,633. Power shovel. Edwin J. Armstrong, Erie, Pa., assignor to Ball Engine Co., same place.

1,163,634. Power shovel. Edwin J. Armstrong, Erie, Pa., assignor to Ball Engine Co., same place.

1,163,640. Culvert form. James M. Cooper, McLeansboro, Ill.

1,163,641. Adjustable false work. Robert A. Cummings, Pittsburgh, Pa.

1,163,825. Machine for preparing road wearing surfaces. Livingston S. Kasson, New York, N. Y., assignor to The A. L. Barber Asphalt Co., same place.

Trade Notes

Warren Brothers Company have removed their principal offices from Temple Place to 142 Berkeley street, Boston, Mass., near the Back Bay railroad station, and a large area of bitulithic pavements on important streets in this neighborhood.

The Kissel Motor Car Company reports a very brisk interest in its new worm drive truck, both on the part of the dealers and the public generally. This truck, which is built to carry a ton, seems to be the most popular size, and the Kissels will make a specialty of it. At the same time they will produce five other models, as in the past.

The combined open-feed water heater and hot water meter known as the Cochrane metering heater, exhibited at the Panama-Pacific Exposition by the Harrison Safety Boiler Works, Seventeenth street and Allegheny avenue, Philadelphia, has received the gold medal award. This apparatus is designed to heat boiler feed water by means of exhaust steam from engines, pumps, etc., and simultaneously to meter the water and record the rate of flow, and to integrate the total flow in any elapsed period. This enables the engineer or plant owner to determine how many pounds of steam are being evaporated per pound of fuel burned under the boilers, and hence to compare the different fuels, different methods of firing, etc. It also shows the effect upon boiler efficiency of cleaning soot and scale off heating surfaces, stopping up air leaks in furnace and settings, and other improvements in operation, and furnishes the means whereby the methods of obtaining high efficiency may be discovered, standardized and maintained.

The South Bend Foundry Co., South Bend, Ind., makers of municipal and all other kinds of gray iron castings, have now the largest and best equipped jobbing foundry in Indiana, excepting Indianapolis, with C. C. Lee, formerly with the E M F and Studebaker Corporations, as superintendent.

The Aberthaw Construction Co. have removed their offices to the Niles building, 27 School street, Boston, Mass., where they may have more commodious offices.

It is estimated that more than 4,000 American farmers are now using motor trucks. This is about 4 per cent. of the total number of trucks sold in the United States. These vehicles have nearly all been bought within the last two or three years, indicating a swiftly proved economic success, a supposition greatly strengthened by a recent careful canvass of the Kissel Motor Car Co. Of the numerous Kissel-Kar trucks in agricultural service, there was not an owner found who had any regrets at having purchased the truck, while not a few reported that they could trace as great an actual saving to it as any piece of machinery on the farm.

The Deckman-Duty Brick Co. and the Wooster Shale Brick Co. have merged under the name of the Medal Paving Brick Co., with Spencer M. Duty, Charles J. Deckman and Herbert C. Moatz of the former company as president, vice-president and treasurer, and W. R. Barnhart and F. E. Schultz of the latter company as secretary and director. The company will operate its plants at Cleveland, Carrollton, Malvern and Wooster, Ohio, with general offices at 1305 Swetland building, Cleveland, Ohio.

The Dunn Wire-Cut Lug Brick Co. of Conneaut, Ohio, has had two prominent additions to its family of licensees, the Burton-Townsend Co. of Zanesville, Ohio, with two plants and a present daily capacity of 160,000 pavers, and the Trimble Paving Brick Co. of Dayton, Ohio, with one plant at Trimble, Ohio, and another at Glouster, Ohio. These two companies are among the largest and most prosperous in Ohio. In addition, the Deckman-Duty Brick Co. of Cleveland, Ohio, another Dunn licensee, has consolidated with the Wooster Shale Brick Co. of Wooster, Ohio, under the name of the Medal Paving Brick Co. This adds one more plant to the three which the Deckman-Duty Co. owned—one at Cleveland, Ohio, one at Carrollton, Ohio, and one at Malvern, Ohio. These accessions give the Dunn Co. twenty-eight licensees, operating forty-five plants.

One point made for the segment block for sewers, made by the American Sewer Pipe Co., Akron, Ohio, is that it can be laid at any time, including cold weather, as the amount of mortar required to set it is so small that the expense of heating materials to prevent freezing is very small.

Trade Publications

Kahn mesh for reinforcing concrete is computed and designs are given for all sorts of work, with full tables of properties and sizes in a booklet of the Trussed Concrete Steel Co., Youngstown, O.

Studebaker delivery wagons are shown in full detail of construction, parts and prices, in Catalog No. 1001 of the Studebaker Corporation, South Bend, Ind.

Bulletin No. 216 of the Chicago Pneumatic Tool Co. is devoted to Hummer self-rotating hammer drills which, among other uses, are suitable for road building, trench work, breaking boulders and quarrying.

One of the set of standard specifications published and distributed by Robert W. Hunt & Co., engineers of inspection and test, Chicago, is that for paving brick adopted by the American Society for Testing Materials.

The Harris Municipal Garbage Incinerator and Steam Generator Co., Nashville, Tenn., is distributing to city officials and others interested in the sanitary and economical disposal of garbage and refuse, a booklet giving plans and specifications for the Harris incinerator and the guarantees offered as to work done and cost of disposing of the garbage. Mr. Harris offers sufficient and satisfactory bonds that his plant will produce the results which he promises.

The Palmer-Moore trucks and their special advantages in use for busses, jitneys and light truck work, such as delivery trucks, ¾ to 1-ton capacity, are set forth in booklets issued by the Palmer-Moore Co., Syracuse, N. Y.

There has just been issued by the Bureau of Standards, of the Department of Commerce, a paper dealing with the factors which influence resistivity of the soil and with the effects of soil resistance on the leakage of currents from street railway lines using the rails as return conductors. Three methods of determining the specific resistance of soil are given and the results of a large number of measurements are tabulated. The principal factors which influence soil resistance are described and their effects on the results of electrolysis surveys and on the escape of currents from street railway tracks are discussed. Copies of the publication, Technologic Paper No. 26, entitled "Earth Resistance and Its Relation to the Electrolysis of Underground Structures," may be obtained free of charge upon application to the Bureau of Standards, Washington, D. C.

Report of Board of Park Commissioners of Cincinnati, O., for 1914. C. H. Meeds, park engineer.

"City Government by Commission," published for the National Municipal League by D. Appleton & Co., New York, at $1.65, is edited by Clinton Rogers Woodruff, secretary of the league and gives the history and development of the system down to the present time.

The Whalen Form for concrete culverts is exploited in a fully illustrated circular from the office in Syracuse, N. Y.

Irrigation by pumping at Del Rio, Tex., is the subject of a number of reprints of articles from engineering periodicals describing the first large American installation of the Humphrey direct-acting explosion pump on a private estate, the system being designed by Alexander Potter, consulting engineer, New York, for the G. Beddell Moore estate.

The Good-roads "Bee" at Cragmere was a community affair.

A "Tarvia Day" at Cragmere

CRAGMERE is a little colony in the Ramapo Mountains in northern New Jersey with two or three miles of roadway which are maintained by the residents. The roads were built five years ago with Tarvia, some of them having been treated with Tarvia about two years later.

This year it was time to treat the roads again. So a contractor was ordered to put the new screened gravel in piles along the road and the Tarvia auto tanks were summoned. Forty residents of Cragmere put on their old clothes on Decoration Day, and turned up, ready for work.

Within two hours they had swept three-quarters of a mile of road and the big tank automobiles were spreading the Tarvia. Then they spread the gravel over the Tarvia and the work was done.

Tarvia
Preserves Roads
Prevents Dust

At the end of the day they found that a mile and a half of steep mountain roads had been thoroughly tarviated and put into condition for two years of hard service at a total cash outlay of about $300. Incidentally they had a fine time!

The whole story goes to show how cheap and easy maintenance becomes if a community adopts tarviated roads.

Booklets free on request, Address our nearest office.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems in your vicinity, the matter will have prompt attention.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria

THE PATERSON MFG. CO., Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

CONTRACTING NEWS

AUTOMOBILES, FIRE APPARATUS.

BIDS REQUESTED.

Quincy, Ill.—Feb. 8, until 1:30 p. m., for motor combination chemical engine and hose car apparatus, with booster pump attachment. Certified check, 5 per cent. of bid. Wm. K. Abbott, Mayor.

CONTRACTS AWARDED.

Rochester, N. Y.—To American La France Fire Engine Co., Elmira, N. Y., contract for 50-gal. chemical tank, at $385; to Peck & Arnold, city, contract for light delivery truck for water works department, at $875 and allowance of $250 for old machine.

CONTEMPLATED WORK.

Hartford, Conn.—Appropriation of $165,000 for installation of fire alarm system and new fire headquarters recommended. Joseph Lawler, Mayor.

Hartford, Conn.—Budget of Fire Board asks $18,375 for tractors for steamers and water tower; $15,100 for motor pumps and one motor ladder truck, and $4,000 for two genral utility trucks. Address Fire Board for further information.

Shelton, Conn.—Motor chemical will be purchased.

Waterbury, Conn.—Committee appointed to investigate purchase of new fire apparatus required. Martin Scully, Mayor.

Atlanta, Ga.—Motorization of entire fire department urged by W. D. Cody, Fire Chief.

Averyville, Ill.—Bids to be advertised at once for automobile combination fire truck. Address Fire and Water Comm.

Chicago, Ill.—The American Can Co., city, is in market for ten motor driven 5-ton trucks. For further information, address W. W. Hodgson.

Joliet, Ill.—Complete motorization of fire department planned for 1916. C. W. Royce, Fire Chief.

Peoria, Ill.—Bids will be asked at once for auto fire truck and ambulance. Mr. Zuckweiler, Commr.

Springfield, Ill.—Installation of triple combination gasoline pumping engine planned. Probable cost, $10,000. Peter Jacobs, Fire Chief.

Richmond, Ind.—Purchase of four chassis and one new body for stations 1, 3, 4 and 5, recommended by Fire Chief E. E. Miller. Alfred Bavis, Pres. Bd. of Pub. Works.

Wichita, Kans.—Ordinance submitted for purchase of motor fire apparatus to cost $5,500. A. G. Walden, Fire Chief.

Donaldsonville, La.—Purchase of auto fire truck for Vigilant Hose Co. No. 3 is being considered. Address Bd. of Fire Commrs.

Beverly, Mass.—Installation of pumping engine at central station advised. H. A. MacDonald, Mayor.

Holyoke, Mass.—Recommendation made for purchase of three triple combinations and three chiefs' cars. J. T. Lynch, Fire Chief.

Malden, Mass.—Purchase of triple combination pump for fire department recommended. Chas. M. Hodgett, Mayor.

Salem, Mass.—Appropriation of $19,000 asked for sprinklers and fire alarm system by school board. Address Bd. of Educ.

Hamtramck, Mich.—Purchase of 60 ft. aerial truck favored by council. Martin Bishop, Fire Chief.

Kalamazoo, Mich.—Installation of three pieces of motor apparatus urged. Jas. C. Baleh, Mayor.

Virginia, Minn.—Purchase of American La France combination motor truck voted. Cost, $5,800.

Trenton, Mo.—Purchase of motor-driven apparatus being considered. M. A. Christopher, Councilman.

Riverside, N. J.—Purchase of combination auto truck with motor pump, chemical tanks and hose reels requested. Address Township Committee.

Vincentown, N. J.—Purchase of automobile chemical truck is urged. S. J. Woolman, Pres. of Company.

Hempstead, L. I., N. Y.—Appropriation of $20,000 for fire apparatus will be voted on shortly. One fire engine, three motor hose wagons and other equipment will be purchased. Address Village Board of Trustees.

Minot, N. D.—Purchase of 2,000 ft fire hose and additional fire truck being considered. Mr. O'Leary, Fire Chief.

Dayton, O.—Specifications being drawn for new fire apparatus. $30,000 available for motorization of department. Mr. Henry M. Waltz, City Manager.

Oklahoma City, Okla.—Purchase of motor fire truck for Station No. 6 being planned. Mr. Hughley, City Commr.

Reading, Pa.—Purchase of seven tractors and five auto chemical wagons asked by various fire companies. Wm. A. Witman, Sr., Fire Commr.

Conde, S. D.—Purchase of chemical engine and other apparatus recommended.

Dyersburg, Tenn.—Purchase of motor fire apparatus being considered. W. A. Fowlkes, Jr., Mayor.

Murray, Utah—New equipment for fire department is to be purchased, including motor-drawn engine to cost about $5,000. J. W. McHenry, Mayor.

Foreign Trade Opportunity—Firm in Venezuela desires to receive catalogs, prices and discounts on motor trucks of from 1 to 2 tons capacity. Correspondence may be in English. For further information address Bureau of Foreign and Domestic Commerce, Washington, D. C. Refer to file No. 19696.

BRIDGES.

BIDS REQUESTED.

Salem, Ill.—Feb. 15, 2 p. m., for nine reinforced concrete bridges, 20 to 70 feet long, 16 to 20 feet roadways. Lee S. Trainor, Co. Supt. of Highways.

Miami, Fla.—Feb. 17, until 7:30 p. m., for two bridges over Miami river, one at 12th St. and one at Ave. D. Reinforced concrete structures with bascule spans. Certified check 10 per cent. of bid. Harrington, Howard & Ash, Consult. Engrs., Kansas City, Mo.

Joliet, Ill.—Until Feb. 12, for bridge over Sugar Creek, length 40 feet, width 24 feet. Probable cost $3,000. Address County Highway Commrs.

Wabash, Ind.—Feb. 15, until 2 p. m., for $44,000 4½ per cent. Wabash county bridge bonds. Frank P. Kircher, Co. Aud.

Hutchinson, Kans.—Until Feb. 23, for two reinforced concrete bridges over Arkansas river. Geo. W. Lee, Co. Clerk.

Burgaw, N. C.—Until March 7, for bridge over Northeast river at Lane's Ferry. Address County Commrs.

Dickinson, N. D.—Feb. 23, until 11 a. m., bids will be received on prices on metal culverts ranging in sizes from 12-in. to 42-in. in diameter and 20 feet in lngth. Certified check, $500. J. L. Hughes, County Aud.

Kingston, Tenn.—Until Feb. 14, for concrete bridge over Emory river at Harriman, to cost about $60,000. Address Co. Commrs.

Wabash, Ind.—Feb. 15, until 2 p. m., for $44,000 4½ per cent. bridge bonds. Frank P. Kircher, Aud. Wabash County.

North Platte, Neb.—Feb. 15, until noon, for bridge across South Platte river near Sutherland, Neb. Certified check, $5,000. C. W. Yost, Clerk Lincoln Co.

Papillion, Neb.—Feb. 10, until noon, for steel truss bridge across Elkhorn river near Gretna, Neb. Certified check, $5,000. W. E. Patterson, Clerk Sarpy Co.

Schuyler, Neb.—Feb. 12, until noon, for one steel truss bridge, with creosoted wood block floor across Platte river. Certified check, $5,000. Ed. F. Vrzak, Clerk Colfax Co.

Huey, Ill.—Feb. 16, 11 a. m., for 55-foot reinforced concrete bridge, 20 feet wide. J. T. Goldsmith, Co. Supt. Hys.

Sigel, Ill.—Feb. 16, 10 a. m., for 12-foot reinforced concrete bridge, 18 feet wide. N. A. Baxter, Co. Supt. Hys.

CONTRACTS AWARDED.

Sterling, Colo.—To P. P. McDonald Co., Denver, Colo., concrete bridge across Platte river, at $27,730.

Rochester, Ind.—To Rochester Bridge Co., city, steel bridge on Michigan road over Tippecanoe river, at $24,495.

Washington, Ind.—To Miller & Brocherding, St. Louis Mo., bridge at Harrimans Ferry, at $16,650.

New York City.—To Rodgers & Hagerty, Inc., 152nd St. and Harlem river, city, Unionport bridge over Westchester creek, at $195,511.

Bryson City, N. C.—To C. W. Requarth & Co., city, four 40-foot span bridges and one 300-foot concrete bridge, at $18,500.

Norristown, Pa.—To Ambler-Davis Co., Phoenixville-Montclair bridge over Schuylkill river, at $80,894.

Houston, Tex.—To J. H. Richardsan Co., city, reinforced concrete bridge across Buffalo Bayou at Milan St., at $37,397.

Pearisburg, Va.—To Virginia Bridge & Iron Co., Roanoke, Va., bridge across New river, at $17,000.

Camden, Ark.—Contract awarded Oates, Haynes & Taylor Co., Texarkana, for repairing Martin free bridge over Ouachita river. Estimated cost $30,000.

Detroit, Mich.—To Candler Dock & Dredge Co., temporary steel and wooden bridge to Belle Isle, at $95,863.

Houston, Texas—To J. H. Richardson & Co., reinforced concrete bridge over Buffalo Bayou, at $42,664.

CONTEMPLATED WORK.

Harrisburg, Pa.—Concrete viaduct over Paxton Creek valley will be built with $300,000 bond issue voted.

Stockton, Cal.—Plans being considered for concrete bridge across Mormon Channel at San Joaquin St. Address City Commrs.

Washington, D. C.—D. C. Commrs. favor replacing, rather than repairing Aqueduct bridge. Address Dist. Commrs.

Aurora, Ill.—Plans being made for two new bridges at Benton and Holbrook Sts. Estimated cost of two bridges of reinforced concrete, $62,000. Myron Tarble, City Engr.

Joliet, Ill.—Two new bridges and possibly three, costing from $30,000 to $40,000, to be constructed at once in Joliet. C. D. O'Callahan, City Engr.

Evansville, Ind.—Preliminary plans for vehicle and traction bridge across Ohio river near Evansville, being drawn. Benj. Bosse, Mayor.

Indianapolis, Ind.—Plans being made for bridge over Fall Creek, at either Shriver Ave. or Senate Ave., to cost about $100,000. Hayes, Chrm., Marion Co. Commrs. Appropriation of $350,000 is asked for bridge over White river at 38th St. Joseph Bell, Mayor.

Leavenworth, Kans.—Bonds totaling $29,330.86 for two concrete bridges in city, registered at State Aud. office. E. W. Crancer, Mayor.

Springfield, Mass.—Sites being considered for bridge across Connecticut river. Address Bridge Commission.

Worcester, Mass.—Plans for bridge over Quinsigamond Lake sent to Harbor & Land Comm. and Public Service Comm. for their approval. Bids will be advertised for shortly. Frederick A. McClure, City Engr.

Birmingham, Ala.—Construction of concrete bridge over Village Creek at 24th St. authorized. Estimated cost, $6,000. Julian Kendrick, City Engr.

Modesto, Cal.—Contract will be awarded shortly for reinforced concrete bridge across Poul river at Modesto, to cost about $75,000. E. H. Anneau, Co. Engr.

Sacramento, Cal.—Bridge across Eel river in Humboldt Co. planned. Estimated cost, $90,000. Address Co. Commrs.

Aurora, Ill.—Plans being prepared for three concrete bridges across river within city, to cost $75,000. Mr. Tarble, City Engr.

Anderson, Ind.—Plans being prepared for cement bridge across White river at 9th St. Mr. McVaugh, County Engr.

Bluffton, Ind.—Appropriation made for bridge across Wabash river in Wabash Twp. known as William Birk bridge. Probable cost $16,000. Address Adams Co. Comnrs.

Hutchinson, Kans.—Contract will be let about Feb. 10 for two concrete bridges over Arkansas river. N. B. Harris, Co. Engr.

Fairbault, Minn.—Resolutions passed for bridge construction during 1916, to cost about $15,000. Frank McKellitt, City Engr.

Kansas City, Mo.—Plans for Swope Park bridge over Blue river on Hickman Mill road approved. Estimated cost, $220,000. H. L. Jost, Mayor.

New York City—Construction of bascule bridge with roadway 60 feet wide and with two 10-foot footwalks over Hutchinson river in Eastchester planned. $180,000 appropriated. Address Bd. of Estimate.

Lima, O.—Viaduct over Ottawa river between north and south Lima planned. Estimated cost $50,000. Carl Bryson, City Engr.

Portland, Ore.—Plans completed for steel and concrete bridge over Balch creek canyon. Estimated cost, $135,000. Address City Engineering Bureau.

Reading, Pa.—Four new bridges planned for 1916 in Berks Co.; one reinforced concrete structure across Schuylkill river at Bingaman St., to cost about $350,000; one in Albany Twp., to cost $7,000; one at Lowbachsville, to cost $4,000, and one in Brecknock Twp., to cost $4,000. Chas. F. Sanders, Co. Engr.

Dallas, Tex.—Contract will be let about Feb. 10 for bridge of concrete at Commerce St. over Trinity river. Estimated cost, $135,000. J. F. Witt, Co. Engr.

Houston, Texas—Bonds amounting to $30,000 will be issued shortly for Milan St. bridge across Buffalo Bayou. Ben Campbell, Mayor.

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RICHMOND, VA. Virginia Railway & Power Bldg.
ST. LOUIS, MO. Railway Exchange Bldg.

Randle, Wash.—210-foot steel span bridge across Cowlitz river planned. J. D. Neville, Co. Engr., Chehalis.

Victoria, B. C., Can.—Four bridge plans being considered, estimated costs as follows: Plan A, $360,000; Plan B, $460,000; C, $377,000; D, $392,000. Costs include bridge construction, cost of land and approaches. C. H. Rust, City Engr.

Kearney, Neb.—Plans being made for concrete and steel bridge over Platte river at this place, length 400 feet. Address Mr. Johnson, State Engineer, Lincoln, Neb.

Perth Amboy, N. J.—Bridge for extending Garretson Ave. under Central tracks decided on by city officials and railroad company. Estimated cost, $30,000. Samuel J. Mason, City Engr.

Franklin, Pa.—Plans being prepared for concrete and steel bridge, connecting Johnstown, Pa., with this city. A. B. Curry, City Engr., Franklin.

BUILDINGS.

BIDS REQUESTED.

Brazil, Ind.—Until Feb. 21, for Senior High School Bldg. Address Bd. of Educ.

Farmland, Ind.—Feb. 11, until 10:30 a. m., for school bldg. for Stoney Creek Twp., Randolph county. T. E. Dickson, Co. Aud.

Warsaw, Ind.—Feb. 28, until 1 p. m., for school bldg. for Monroe Twp., Kosciusko County. Talman H. Idle, Twp. Trustee.

Des Moines, Iowa—Until Feb. 15, for two-story and basement fireproof addition to hospital at Oakdale, Ia. H. F. Liebbe, State Archt.

New Orleans, La.—March 22, until noon, for addition to bldg., Pumping Station No. 3 (Contract 76-D). F. S. Shields, Secy. Sewerage & Water Board, Room 508, City Hall Annex.

Paterson, N. J.—Feb. 10, until 8 p. m., for heating and ventilating plant and heating boilers for Public School No. 10. Certified check, 2 per cent. of bid. Leonard Stolk, Pres. Bd. of Educ.

Harrisburg, Pa.—March 7, until noon, for building for women for manufacturing purposes at Penn. State Hospital. Certified check, $300. Dr. H. H. Orth, Supt.

Springfield, Mass.—Feb. 16, until 10 a. m., for constructing Hampden County Training School, to be erected in Westfield St., Feeding Hills. Address County Commrs.

CONTRACTS AWARDED.

New Orleans, La.—To James A. Petty, city, isolation hospital near St. Louis and Toulouse Sts., at $17,478.

New Berford, Mass.—The J. W. Bishop Co., city, lowest bidders for new central fire station. Bid $121,990.

Durham, N. C.—To Geo. A. Fuller Const. Co., Washington, D. C., county court house, four stories and of Bedford stone, at $221,500.

New Bern, N. C.—To Rhodes & Underwood, city, addition to Craven County court house, at $18,433.74.

Springfield, Tenn.—To Pauley Jail Co., St. Louis, county jail, at $27,000.

College Station, Texas—To W. C. Hedrick Construction Co., Dallas, hospital building for Texas Agricultural & Mechanical College, at $50,000.

CONTEMPLATED WORK.

Safford, Ariz.—Plans being prepared for two-story court house for Graham Co. Estimated cost, $45,000. Lescher & Kibbey, Archts., Phoenix, Ariz.

Los Angeles, Cal.—Plans being prepared for branch library bldg. on Santa Monica Blvd and Madison Ave., East Hollywood. Estimated cost, $30,000. C. H. Russell, Archt.

Denver, Colo.—Children's Hospital, to cost about $150,000, will be started in spring. W. H. Sharpley, Mayor.

Pueblo, Colo.—Site selected for proposed city hall and auditorium. Probable cost of bldg., $300,000. Fred Olin, City Commr.

Chicago, Ill.—Plans being drawn for county hospital annex to be erected at 35th and State Sts. Estimated cost, $100,000. E. E. Hall, County Archt.

Joliet, Ill.—Addition to Silver Cross Hospital to cost $100,000 and new school bldg. on Eastern Ave. to cost about $58,000 planned for this year. C. W. Webster, Archt. for hospital. Address Bd. of Educ. for information concerning new school.

Silvis, Ill.—City hall, to cost about $15,000, being planned. Frank Shannon, Village Treas.

Delphi, Ind.—New county court house voted. Probable cost, $171,000. Address County Commrs.

Indianapolis, Ind.—Appropriations of $800,000 for tuberculosis hospital and $60,000 for Board of Children's Guardians' Home made. Joseph Hayes, Chrmn. Bd. of County Commrs.

Shelbyville, Ind.—Construction of new county infirmary being urged by State Board of Charities. Probable cost, $30,000. Address Co. Commrs.

Des Moines, Iowa—Court house for Boone Co. being planned. Probable cost, $200,000. Contract will be let during April. Norman T. Vorse, Archt.

Jennings, La.—Bids will be received in February for court house for Jefferson Davis parish. Col. Stephens, Archt., Baton Rouge.

Spencer, Iowa—City plans erection of city hall in 1916. Address City Commrs.

Worcester, Mass.—High school bldg. plans being considered. Geo. M. Wright, Mayor.

Clarksdale, Miss.—Remodeling court house contemplated. J. W. Cutler & Chas. W. Clark are interested.

Binghamton, N. Y.—Addition to courthouse to cost about $69,000 recommended by special committee of investigation. E. W. Dickerman, Archt.

Buffalo, N. Y.—New city hall being considered. Estimated cost, $2,000,000. John F. Malone, Councilman in charge of Public Bldgs.

Seneca Falls, N. Y.—Municipal building being considered. Lewis J. Avery, Village Pres.

Bridgeton, N. J.—Movement started for new city hall. Arthur C. Whitaker, Mayor.

Plainfield, N. J.—Building Comm. to be named at once for new city hall. Mr. Calkins, Mayor.

Dobson, N. C.—Contract will be let about April for four-story fireproof court house, to cost about $80,000. Harry Barton & Raleigh J. Hughwa, Assoc. Archts., Greensboro.

Eaton, O.—Bonds amounting to $250,000 will be sold March 1 for proposed court house and jail. Architect will lbe selected in about two weeks. A. L. Reid, Chrmn. of Bldg. Commission.

Toledo, O.—Plans being considered for municipal hospital. Chas. M. Milroy, Mayor.

Tyrone, Pa.—Erection of city hall being considered. Richard Beston, Burgess.

Greenville, Tenn.—$50,000 appropriated for new court house for Green Co. J. R. County to have charge of work. Joseph G. Kilday, Chrmn. Co. Court.

GARBAGE DISPOSAL.

COTEMPLATED WORK.

Ann Arbor, Mich.—Incinerator plant or reduction plant being conidereds. Charles A. Sauer, Mayor.

Evanston, Ill.—$25,752.05 appropriated for incinerating plant. H. P. Pearsons, Mayor.

Lincoln, Neb.—Specifications for garbage disposal plant filed with city council. Estimated cost, $30,000. Adna Dobson, City Engr.

Springfield, Ill.—Garbage disposal system will be provided for in new city budget now under consideration. Charles Bauman, Mayor.

LIGHTING.

CONTEMPLATED WORK.

Columbus, Ind.—Plans being prepared for municipal electric light plant. Karl Volland, Mayor. Wm. R. Wright, City Engr.

Elkhart, Ind.—Contract will be awarded to Indiana & Michigan Electric Co., for lighting city, at bid of $16,536 per annum for 600 type C Mazda lamps.

Ottawa, Kans.—Bids will be asked about February 1 for White Way lighting system. F. M. Harris, Mayor.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bath, W. Va.—February 15, until noon, for about 15,000 sq. yds. 6-in. reinforced concrete, plain concrete or brick with concrete base paving and curbing inlets, storm sewers, etc. J. A. Risinger, Mayor.

Covington, Ind.—March 8, until 10 a. m., for stone or gravel road construction in four townships in Fountain county. H. W. Newlin, Co. Aud.

Decatur, Ind.—February 8, until 10 a. m., for macadam road construction in various townships in Adams county; about twelve roads in all. T. H. Baltzell, Co. Aud.

Evansville, Ind.—February 10, until 10 a. m., for rock road in Center township, Vanderburgh county. C. B. Beard, Co. Aud.

Fort Wayne, Ind.—February 23, until 10 a. m., for macadam roads in Madison, Monroe and Wayne townships, Allen county. Will Johnson, Co. Aud.

Mitchell, S. D.—Until February 10, for about 2 miles paving, including concrete, double and single; asphaltic concrete; creosote blocks and brick. Thomas Eastcott, City Aud.

St. Cloud, Minn.—Until February 15, for creosote block pavement on Tenth street bridge. George Mahnusen, City Clerk.

Wausau, Wis.—February 15, until 10 a. m., for about 30,000 yds. vitrified brick pavement on Forest street and Grand avenue; certified check, 5 per cent. of bid. H. E. Marquardt, Pres. Bd. of Pub. Works.

CONTRACTS AWARDED.

Albany, N. Y.—To Michael O'Brien, Cortland, N. Y., State Highway No. 9, at $11,948, and No. 21 at $20,814.50; to B. F. S. Co., Herkimer, No. 1, at $48,802.75; to Newport Construction Co., No. 16, at $38,398.50.

Duluth, Minn.—To D. H. Clough, city, paving First street with creosote blocks and granite curbing, at $69,864.55.

Iowa Falls, Iowa—To Ford Paving Co., Cedar Rapids, Iowa, asphaltic concrete pavement on various streets and alleys, at $82,620 for streets, $2,072 for alleys, $15,750 for curbs and gutters and $4,000 for grading.

New Brunswick, N. J.—To Liddle & Pfeiffer, Perth Amboy, N. J., for section 2 of Cranberry turnpike road improvement, at $115,444.

Portland, Ore.—To Standifer-Clark Co., city, grading Butler Canyon and Pitcher Canyon roads, at $21,894.

Winona, Minn.—To Hanlon & Oakes, Sioux City, Iowa, 55 miles road paving in Winona county, at $246,00.

COTEMPLATED WORK.

Abingdon, Ill.—Plans made for paving construction for 1916 involve expenditure of $211,000. Total amount will probably be $250,000. Materials, probably brick and concrete. A. S. Rickey, Surveyor of Knox County, engineer in charge.

Alliance, Ohio—Ordinance passed for the grading, draining and paving of North Freeman avenue, with brick blocks. Chas. O. Silver, Clerk.

Augusta, Me.—$500,000 will be available for state highway construction in 1916. Paul D. Sargent, Chief Engr., State Highway Comm.

Astoria, Ore.—Contract will probably be let April 1 for brick and asphalt pavement on 36th, 37th and Duane streets. G. T. McLean, City Engr.

Blackfoot, Idaho—Plans being made for 25 blocks of paving on main streets. C. W. Berryman, Sr., is interested.

Burlingame, Cal.—Resolution introduced in council for 3,000,000 sq. ft. asphalt pavement thru Easton. Estimated cost $300,000.

Burlington, Ky.—Bond issue of $20,000 for good roads construction in Boone county will be voted on May 8. D. B. Wallace, Chrmn. Dixie Highway Council.

Canton, Ohio—Plans completed for improvement of Bank Place, S. W., and of Lawn avenue, N. W. Estimated cost of former $10,325. W. E. Sarver, City Engr.

Carthage, Mo.—Plans being made for paving Main street, S., from 5th street to Centennial avenue, with asphaltic concrete. F. R. Newton, City Engr.

Champaign, Ill.—About $150,000 will be expended for street improvement this year. E. G. Swigart, Mayor.

Clayton, Mo.—Bond issue of $3,000,000 for road paving in St. Louis county will be voted on February 15. Address the Co. Commrs.

Concordia, Kans.—About 8,650 sq. yds. asphaltic concrete on 5-in. concrete base, 5,000 ft. combined curb and guter, concrete, and 4,000 cu. yds. excavation being planned. Estimated cost, $18,898. W. T. Short, Mayor.

Creston, Iowa—Resolution introduced by council providing for about 100,000 yds. of street paving and 75,000 ft. of curbing. Various types of pavement under consideration. Carl Davenport, City Clerk. Theo. S. De Lay, City Engr.

East Moline, Ill.—Eight blocks of brick pavement on 17th avenue being considered. Estimated cost, $29,547. H. G. Paddock, City Engr.

Eaton Rapids, Mich.—Bond issue of $13,000 for paving purposes will be voted on February 7. Address City Commrs.

Edwardsville, Ill.—Bond issue of $1,200,000 for hard road surfacing in Madison county being considered. Address Madison County Hard Roads Comm.

Edwardsville, Ill.—Paving of approaches to city of Alton-Springfield road with brick

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and concrete, to cost about $29,322.38, is planned. Address Bd. of Local Improvements.

Everett, Wash.—Expenditure of $750,000 for road improvement in Snohomish county during 1916 recommended. Address Bd. of Co. Commrs.

Fort Wayne, Ind.—Bd. of Pub. Works petitioned to pave 45th street this year. Frank N. Randall, City Engr.

Hillsdale, Mich.—Paving Manning street 30-ft. wide with sheet sphalt or asphaltic cement planned. Chas. C. Cox, City Engr.

Jamaica, N. Y.—Construction of roadway along Jamaica Bay front from Rockaway Park to Far Rockaway being urged. Estimated cost of entire boulevard, length 5 miles, $250,000. Address Bd. of Estimate.

Kearney, Neb.—Ordinances creating three paving districts passed.

Lebanon, Ind.—Resolution passed for brick pavement, sidewalks, curb and gutter on West Washington street. Estimated cost, $12,757. Walter Whitecotton, City Engr.

Little Rock, Ark.—About $3,811,000 will be expended for highway construction in various counties. H. R. Carter, Engr. Dept. of State Highways.

Lonsdale, Pa.—Plans adopted for improvement of eleven streets, to cost $18,-000. H. E. Christenberry, Mayor.

Middleburgh, N. Y.—Contract will be let in March for road construction in towns of Gilboa and Conesville. Estimated cost, $44,300. Address Cmmrs. of Schoharie County.

Minneapolis, Minn.—Plans being made for 51 miles paving of boulevards. Theodore Wirth, Park Supt.

Minneapolis, Minn.—Plans adopted for spending $1,500,000 during 1916 on Minneapolis and Hennepin county highways. W. G. Kyle, Mayor.

Moline, Ill.—About $150,000 will be expended for street paving this spring and summer. Paving of 5th avenue, 9th and 18th streets with brick will be considered January 22. Probable cost, $21,381. Lyle Payton, City Engr.

New Philadelphia, Ohio—Improvement of main market road No. 9 planned. County favors spending $35,000 for work if state appropriates a like amount. Address Commrs. of Tuscarawas County.

Odebolt, Iowa—Plans for about 75 blocks pavement will be completed very shortly. Brixey, Standevyn & Boynton, Consulting Engrs., Omaha, Neb.

Ottawa, Ill.—Plans completed for resurfacing streets at cost of $108,545.38, and for new paving, with concrete foundation, at cost of $112,498.02. George L. Farnsworth, City Engr.

Pawnee, Okla.—New paving districts being planned. The Benham Engineering Co. will prepare plans shortly. Address, Oklahoma City, Okla.

Princeton, Ill.—Resolutions adopted for brick block pavement on four streets. Mr. Anderson, Mayor.

Peoria, Ill.—Resolution adopted for paving Bacon-Summer district; estimated cost, $72,000. Address Bd. of Local Improvements.

Rochester, N. Y.—Extension of Averill avenue being considered. Estimated cost, $75,000. F. T. Elwood, City Engr.

Rock Island, Ill.—Resolution adopted for repaving 20th street, from 7th to 18th avenues, with brick. Wallace Treichler, City Engr.

Salem, Ohio—Plans under way for paving East 7th street with brick, with 4-in. concrete base and stone curb. Estimated cost, $11,000. B. M. French, City Engr.

St. Joseph, Mo.—Between $160,000 and $170,000 will be spent on road construction in Buchanan county this year. Ray L. Cargill, County Highway Engr.

St. Paul, Minn.—About $1,500,000 by state, $2,000,000 by counties and $3,500,000 by townships will be expended this year for road construction. George W. Cooley, State Engr. of State Highway Comm.

Seattle, Wash.—National highway extending from Seattle, Wash., to Savannah, Ga., is being planned. Route will be chosen within next few weeks. Robert H. Manly, of Omaha Commercial Club and of County Highway Commrs., is interested.

Shreveport, La.—Plan adopted for encircling city with 32-mile boulevard and to reclaim river front, by City Plan Committee of Chamber of Commerce. J. P. Anson, Archt., city. S. A. Dickson, Mayor.

Sterling, Ill.—About 28 blocks of paving planned for this year. E. O. Hills, City Engr.

Susanville, Cal.—Bond issue of $15,000 for street improvements will be voted on February 8. R. M. Hamilton, Mayor.

Utica, N. Y.—About $120,000 will be expended for paving this year. James D. Smith, Mayor

SEWERS.

BIDS REQUESTED.

Des Moines, Iowa—Until February 23, for sewer system in Closes Creek district, to cost about $209,500. Work includes 87,253 ft. 10-in., 9,566 ft. 12-in., 14,525 ft. 15-in., 2,591 ft. 20-in. vitrified pipe; 411 ft. 24-in. and 5,860 ft. 30-in. pipe or blocks; also 3,988 ft. concrete brick or segment block sewer. D. E. Thomas, Asst. City Engr.

Kendallville, Ind.—Until February 29, for sewer construction for south and west portions of city, length 4 miles. F. L. Keubler, City Engr.

Newark, N. J.—Until March 14, for section sewer of Passaic Valley trunk sewer. Address Passaic Valley Sewerage Comm.

Shaker Heights, Ohio—February 8, until noon, for storm and sanitary sewers in Shaver boulevard. Carl A. Palmer, Village Clerk, First National Bank, Cleveland, Ohio

COTEMPLATED WORK.

Belton, Tex.—Bond issue of $40,000 voted recently for taking over city sewer system and for extension of same. C. E. Leonard, City Engr.

Bridgeport, Conn.—An appropriation of $218,160 asked for new sewer construction this year. Alfred H. Terry, City Engr.

Clovis, N. M.—Contracts will probably be let in May for sewer improvements, to include 15,000 ft. 8-in. vitrified pipe. Average cut 7 ft.

Evansville, Ind.—Plans adopted for the Blankenburg sewer. Estimated cost, $33,-140. J. D. Saunders, City Engr.

Fresno, Cal.—Plans being made for sanitary sewer system, capable of accommodating city of 100,000 population. B. E. Cronkite, City Engr.

Garretson, S. D.—Bond issue of $3,000 for sewerage system will be voted on February 21.

Hammond, Ind.—Resolution passed for Calumet avenue district sewer. Estimated cost, $215,563.30. Address Bd. of Pub. Works.

Hagerstown, Md.—Bond issue of $750,000 for sewerage system authorized. J. McP. Scott, Mayor.

Kokomo, Ind.—Plans being made for 60-ft. concrete arch sewer in Washington street, from Wildcat interceptor to Morgan street; length, 1½ miles. Estimated cost, $60,000. Address Bd. of Pub. Works.

Lafayette, Ind.—Plans completed for the Sixth Ward sewer. Estimated cost, $80,000. Harry Overesch, City Engr.

La Junta, Col.—Plans being made for brick sewer on First street. Estimated cost, $10,000. F. T. Lewis, City Engr.

Milledgeville, Ga.—Sewerage system for state institutions in city being planned. T. P. Stanley, Engr., Athens, Ga.

Murray, Utah—Enlargement of sewer district planned. J. MacHenry, Mayor.

Muskogee, Okla.—Vitrified pipe outfall sewer to Arkansas river being considered. Bond issue, $25,000. E. S. Peterson, City Engr.

Northwood, Iowa—Installation of sewer system being planned for this year.

Port Arthur, Tex.—Bond issue of $180,-000 voted for drainage and sewers, including levees and pumping plant.

Rock Island, Ill.—Detailed estimates being prepared for storm drainage system in southwestern section of city. Probable cost between $80,000 and $150,000. Wallace Treichler, City Engr.

Salt Lake City, Utah—Bids will be advertised shortly for discharge outlet pipe line from proposed pumping station at 11th and 9th streets to connect with present gravity outlet sewer at Jordan river. Estimated cost, $85,000. Sylvester Q. Cannon, City Engr.

Spencer, Iowa—Sewerage and water system extensions, costing $12,000, planned for 1916. Address City Commrs.

Myrtle Point, Ore.—The city engineer has been instructed to plan a complete sewer system to cost about $20,000.

SEWAGE DISPOSAL PLANTS.

COTEMPLATED WORK.

Allentown, Pa.—Sewage disposal project being considered. C. W. Rinn, Mayor.

Clarksburg, W. Va.—Sewage disposal plant being planned. George W. Fuller, Consulting Engr., New York City.

Galveston, Tex.—Installation of sewage disposal plant in section west of 39th street urged by city engineer. Probable cost, $250,000. A. T. Dickey, City Engr.

Grand Rapids, Mich.—Council committee favors $358,000 expenditure for disposal system. George E. Ellis, Mayor.

Hampton, Va.—Plans being prepared for sewage disposal plant by Green Star Engr. Co. Girard Chambers, City Engr.

Indianapolis, Ind.—Sewage disposal system being considered. George W. Fuller, Consulting Engr., New York City.

Rochester, N. Y.—Completion of section of third conduit and sewage disposal plant being urged. H. H. Edgerton, Mayor.

STREET SIGNS.

BIDS REQUESTED.

Chicago, Ill.—February 5, until 11 a. m., for about 4,000 street signs. Certified check, $100. W. T. Moorhouse, Commr. of Pub. Works.

WATER WORKS.

BIDS REQUESTED.

Colville, Wash.—Until March 1, for water supply system, to include 3 miles 10-in. and 12-in. pipe, concrete reservoir and concrete dam. Estimated cost, $20,000. Sawyer Bros., Consulting Engrs., Spokane, Wash.

Cullman, Ala.—Until April 1, for laying 2 miles 6-in. water mains. Probable cost, $12,000. A. G. Coe, City Clerk.

CONTEMPLATED WORK.

Amarillo, Tex.—Plans being prepared for new water supply and water works improvements. Burns & McDonnell, Consulting Engrs., Kansas City, Mo.

Augusta, Ga.—Enlargement of the water works plant may be undertaken this year. Improvement will include one 10,000,000-gal. pump, one 75,000,000-gal. reservoir, coagulating basin and 6 or 8 miles water mains. Nisbet Wingfield, City Engr.

Clio, Mich.—Plans ready for water works system. Estimated cost, $25,000. Russell Murdock, Engr., Detroit, Mich.

Detroit, Mich.—Vast extensions to village water system of Ford village being planned. Mason L. Brown, Engr. in charge. Wm. G. Perry, Village Pres.

Everett, Wash.—Plans for water works supply system will be completed by April 1. Bond issue voted, $600,000. Burns & McDonnell, Consulting Engrs., Kansas City, Mo.

Glendive, Mont.—Plans in progress for water works filtration system. Estimated cost, $70,000. Burns & McDonnell, Consulting Engrs., Kansas City, Mo.

Hendersonville, N. C.—Installation of water supply system, to cost about $150,-000, being planned. C. E. Brooks, Mayor.

Marion, Ill.—Plans being considered for new municipal water plant. Frank Payne, City Engr.

Reidsonville, N. C.—Town contemplates installing water works system. Address Town Trustees.

Vinton, Iowa—Installation of new machinery, pumps, engines and dynamos, compressors, etc., at water works plant planned for this year. Probable cost, $24,-000. J. B. Hill, Iowa City, is engineer in charge.

MISCELLANEOUS.

BIDS REQUESTED.

Paterson, N. J.—February 10, until 8 p. m., for heating and ventilating plant and heating boilers for Public School No. 10; c. c. 2 per cent. of bid. Leonard Stolk, Pres. Bd. of Educ.

St. Paul, Minn.—Until February 7, for 10-ton steam or gasoline road roller. Address County Aud.

St. Paul, Minn.—February 7, until 10:30 a. m., for heating and ventilating equipment for Randolph Heights School. August Hohenstein, City Purchasing Agent.

St. Paul, Minn.—February 7, until 10:30 a. m., for furnishing gasoline, kerosene, lubricating oils and greases required during 1916; c. c. 10 per cent. of bid. August Hohenstein, City Purchasing Agent.

CONTEMPLATED WORK.

Bluffton, Ind.—Purchase of municipal asphalt repair plant being considered. John Mock, Mayor.

Brightstown, Pa.—Establishment of municipal gas plant is being considered. Address City Council.

Minneapolis, Minn.—Construction of municipal paving plant is urged in annual report of Park Supt. Wirth. Address Bd. of Park Commrs.

Port Arthur, Tex.—Bond issue of $20,000 voted for municipal abattoir. Address City Commrs.

MUNICIPAL ENGINEERING

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EDITORIAL

ROADS OF THE FUTURE

An article elsewhere in this number gives some figures to show the magnitude of difficulties met in putting motor trucks into operation on country roads. The argument is only less pertinent in cities because the average city will prepare its streets for the traffic coming to them, whereas the local authorities responsible for the building of country roads are prone to reflect the opinions of their constituents and demand the regulation of the traffic rather than the improvement of the roads.

The figures given demonstrate that the condition of the roads does much to regulate the traffic, but not enough, because whenever a road is good enough for a truck to get over it the truck is likely to be there and to cut the road up so that when bad weather comes it is again impassable to motor trucks or anything else.

The demonstrations of the economy of motor trucks for hauling farm produce to market, particularly the produce of the higher values, are becoming so numerous and so indisputably strong that the farmers and the country road builders are beginning to recognize their value, and their opposition to the improvement of the main traveled roads to carry the heavier weights as well as the larger number of vehicles must soon diminish and ultimately disappear. The farmer himself will profit by the new methods of transportation, and he must soon be driven from his untenable position that the traffic must be regulated to suit the roads, and join in the demand that the roads be built to fit the traffic.

We have called attention frequently to the early waste of money by State Highway Departments caused by lack of consideration of the probable increase in weight as well as volume of traffic, resulting in the construction of roads which were too light for the traffic which developed immediately upon the completion of the roads. Many of these roads have been reconstructed, others resurfaced and others are still sources of excessive maintenance expense in order to keep them in passable condition for this new heavy traffic.

The newer State Highway Departments should profit by these earlier lessons and not fall into the same errors.

We have been demonstrating the proposition as thoroly as possible from a theoretical consideration of the combination of facts available. The figures referred to above add practical points to the other arguments and point the way to the source of still other information which will give still further aid.

The vicious circle will soon be broken, and it will be impossible except in the most remote districts to argue against the fullest improvement of the roads because the traffic is not there to demand it, whereas the traffic is not there for the sole reason that the road is not good enough to carry it.

GLORIFICATION OF CONCRETE

The cement show and the attendant conventions in Chicago in February have put the annual emphasis on the uses of concrete which has ranged from the simplest and most empirical machine for performing some little operation, exhibited in the Coliseum, to the most abstruse theoretical discussion of the composition of cement and its action in setting at the American Concrete Institute.

While such a concentration upon one subject may sometimes carry one forward too fast, there is no question that such concentration results in a more rapid advance in both theory and practice of the use of the product and is of the utmost benefit to the user of cement, as well as to those interested in supplying the materials and machinery required for concrete construction. The rapidity of this advance can be judged only by going to the meetings and the exhibitions and comparing the presentations with those of former years. One not continually in touch with the development cannot express his astonishment at the rapid strides made each year.

AGGREGATES FOR CONCRETE

The most important subject at the present time in the engineering world is that of aggregates for concrete. It was the center of attention at the recent meetings of the American Concrete Institute and the Conference on Concrete Road Building, and occupied a very large share of both programs. The fact is that the development of the use of concrete roads has been faster than the development of experts to supervise their construction, and when it comes to making specifications for materials which will be definite enough to turn over to less experienced superintendents of construction the experts find that they do not know enough about either broken stone or gravel to be able to make fool-proof specifications. Hence the anxiety and the pressure from all sides upon the expert investigators. Some of their work is outlined in this number and other endeavors will be described as they show promise of good results.

WATER SUPPLY PROBLEMS

ALONG THE OHIO RIVER

By Webster Frank, M. C.

The small cities along the Ohio river formerly had no particular problems regarding their water supplies, for any practicable intake would give them all the water they wanted for all purposes, sedimentation being desirable for a part of the year, tho by no means indispensable. As population, manufacturing and mining have increased the pollution of the river has increased, and the problems of these small cities have multiplied. This article tells how some of them have been solved in a practical fashion, and the descriptions of failures and successes give indications of how not to do it as well as how to get good results.

FORTY years ago the Ohio river, from Pittsburgh to Wheeling, bore close inspection as a thing of beauty. Its color was pleasing, the people drank the water, and sometimes bathed in it. Fish grew to a healthy old age in its waters, and many a man made his pin money from the sales of his night catches on anchored lines set out each evening.

Today the scene is vastly different. The waters are green and murky with sewage. Whole schools of fish, yes, acres of them, have floated belly-up to their happy fishing grounds, and the stench from their decaying flesh has been loud enough to attract the buzzards. Any one who drinks the water nowadays does so at the great risk of burning out his internal plumbing system.

The change from purity to impurity of the water has been brought about by the increase of the population, and from the scores of manufacturing plants that now adorn both of the banks of the river.

Numerous private and municipal sewage systems have been built to drain the pollutions from humanity and from manufacturing processes into the stream. From the manufacturing plants is now emptied a flood of acidulated fluids from various cleaning baths, and of poisonous liquids from electroplating and decorating solutions. The raw water is now used only as a transportation system to float coal boats, and for carrying away refuse.

The changed conditions in the Ohio river have brought up some serious water supply problems for the people to solve. Naturally, the people have been slow to give way to new and more costly methods. The springs and wells had to be discarded. These wells have been both private and public. The latter were located on the street corners, and they were kept in good condition or repair by the town constable.

Before the advent of the city water works, the wash-day trade was supplied by enterprising draymen with their casks mounted on two-wheeled carts. They would drive into the river up to axle depth, and load up by using a bucket nailed to a stout bar for a ladle. Then the delivery into the house barrels was made thru a hose from the bottom of the cask. The charge was 25 cents per load of three barrels.

The Wellsburg Municipal Plant.

The development of a typical water plant along the Ohio river as used by a town having a population of about 5,000 people, is well illustrated by the one at Wellsburg, W. Va. This plant was started in a very modest way. Really, the first running water for commercial use was furnished by a private individual, Mr. Tucker by name, who erected a wooden tank on his yard and piped his own house for both bath and kitchen service. He also had the first hose sprinkling service in town. A small boiler and pump at the river's edge did the pumping. Several nearby residents availed themselves of the privilege of purchasing the water.

Following the educational leaven of the private plant came the one built by the city to furnish water to every citizen and to insure purer water. At first a crib intake suction pipe was laid in the gravel of the river bed and water that was partly used. But this construction was of short duration, owing to its lack of stability and the poor water.

At present the supply comes from eight wells sunk in the river bed. These consist of 60-inch cast-iron sections sunk into the underlying sand and gravel and closed on top, excepting that an 8-inch suction pipe leads from each well to the 16-inch suction line to the pump.

After a while these eight wells did not furnish enough water for the service, and a large well was sunk near the water's edge on shore. This well is 15 feet in diameter and 35 feet deep. The wall is 19 inches of brick with a reinforced concrete cover. At first this well was not a success, as it was not deep enough to shut out the up-flow of sand and gravel from the bottom. This has been remedied by driving sheet piling inside the well casing to hard pan, and cleaning out the contents to the bottom. Then numerous lengths of cast-iron pipe were driven radially from the casing into the water bearing gravel surrounding the well. This plan has given the quantity of water needed at present, but the water is harder than that from the river wells.

THE PUMPING PLANT.

The pumping machinery is housed in a substantial two-story building of brick and concrete, as shown in the illustration. The second-floor elevation is necessary in order to protect the equipment from the frequent high water inundations to which the Ohio river subjects the valley.

The wall of a dry well about 25 feet in diameter extends from 3 feet or so above the station floor, and the well is deep enough to locate the pumps within suction distance of the water; that is, the intention has been so to do, but it is said that the suction is as great as from 17 to 25 feet.

The first pump installed was a Knowles compound duplex with 12½ and 18-inch steam cylinders and a 10½x12-inch pump plunger.

Later there has been added a twin vertical compound Epping-Carpenter engine, located on the station floor, and having steam cylinders 16 and 25 inches, operating a pump that is 12½x24 inches and having a capacity of 2,000,000 gallons.

The boiler plant has one 150-h.p. Erie return tubular boiler, and one 200-h.p. Casey-Hedge boiler with two Morrison furnaces. The former has sixty-eight 4-inch tubes and is fired with gas. The latter has eighty-four 4-inch tubes and two 3-foot Morrison coal burning furnaces. The shell is 13/16 inch, quadruple riveted, and carries a working pressure of 160 pounds.

The reason that both fuels are used is that an old contract

between the city and the gas company allows 400,000 cubic feet of natural gas per month for a flat rate of $25. As the price of natural gas has been greatly increased since then, any additional fuel needed is furnished by bituminous coal at $1.45 per ton for run-of-mine coal. The gas supply lasts but about six days per month now.

The new Casey-Hedge boiler, while of efficient design, is not yet lagged, owing to the fact that no appropriation has been made to cover the cost of $150 needed for the work.

THE RESERVOIR.

From the pumping station to the reservoir, over one mile distant, two 10-inch lines of pipe are laid. The plan of using two pipes gives excellent satisfaction when cleaning the reservoir, making repairs, and the like. The first reservoir was a small affair built on the side of the hill. But the new one, which was constructed in 1903, is located on a level field on top of the hill. The elevation gives a static pressure of 141 pounds at the pumping station.

The new reservoir is square, 225 feet on a side, with curved corners. It is deep enough to hold 16 feet of water. The gravel-concrete wall is about 12 inches thick with a coping of 2 feet or so. The top of the wall is vertical for about 4 feet and the lower part slopes at 45 degrees into the floor of the bottom.

Besides the two 10-inch inlets, there is a 16-inch cleaning outlet led into a ravine in the rear of the reservoir. This cleaning pipe has a door valve. The reservoir is cleaned once per year. The sides are scrubbed down and the whole bottom washed free of filth. There is no screen or fence around the wall to prevent leaves and small animals from accumulating in the water. To clean the reservoir requires five men for two days.

When first built this reservoir leaked badly. Quite a number of cracks developed in the walls. Aside from the general patching required, the leaking was not stopped until the surface of the gravel-concrete was coated with two coats of linseed oil.

WATER RATES.

Flat rates have prevailed, but meters are being put in gradually. The new state law requires the installation of meters when demanded by the user.

The water user is most interested in these two things: Quality and cost. The quality of the water from the Wellsburg plant has never been ideal, as it is not always clear, it has some hardness, and the purity is not above question. The scheme of wells as actually operated does not furnish real filtered water, so that the quality is liable to vary from excellent to dangerous.

As to cost, the water plant owned by the municipality is a great success. The rates are surely low and the quantity enough for all purposes. In the first place the city has sixty-eight high pressure fire plugs and all the water needed for sprinkling absolutely free. Water is also furnished free to the city-owned buildings.

About 5,000 people use the water, and all the manufacturing plants are large users, because, for some reason or other, their private plants do not supply their needs. The family service, of course, is the standby for revenue to cover cost of operation. The flat rates will be understood from an inspection of the accompanying quarterly bill.

It will be noted that the first item is a charge based on the rental value of the house. The rate is ¾ per cent. of this value. Thus, if the laborer's house would rent for $6 per month, or if he pays this rent for it, then the item of fixed charge per quarter is ⅜ per cent. of $72, or 27 cents. The charge is also 12½ cents per quarter for each individual in the family, and this is duplicated for the privilege of a bath. The charge for a toilet is $1.25 for a quarter, and fixed charges

THE PUMPING STATION *of the municipal water works plant at Wellsburg, W. Va., taking water from the Ohio River.*

are made for autos, lawn hose, motor washers, etc. The meters are read monthly, but the bills are rendered quarterly.

The typical bill, as shown, is that paid by a well-to-do family of man and wife for the quarter ending July 1, 1915. As the new law requires meters when demanded, a few have been installed in Wellsburg already. A comparison of the bills paid "before and after" shows clearly either that the water service is very reasonable and of low cost, or that the meter rates are too low.

Man, wife and child, no closet in the house, meter cost, 60 to 90 cents per quarter.

Family of five, flat rate, $5.00; meter rate, $1.30.

Family of a physician, including auto, 60 cents.

Barber shop, $3.30.

Large livery stable, $7.50.

Restaurant, $6.30.

Three-story store building, one store and three families, $2.10.

COST AND VALUE OF THE PLANT.

The entire plant represents an outlay of about $65,000, with a bonded indebtedness on hand of about $25,000 or $30,000 yet to pay off. A spot cash price of $125,000 has been offered for the plant by parties proposing a stock company to operate it. The offer was promptly refused by the city fathers.

The Follansbee Stock Company Water Plant.

One of the latest water plants is that in the new town of remarkable development, Follansbee, W. Va. This water plant is owned by a stock company and has been a great success from the beginning.

The plant seems to have been of the right kind, put in at the right time and in the right way. No changes or additions have been made.

The water for this plant is secured from drilled wells sunk at a considerable distance inland from the river. There are three of these wells, which are 10 inches in diameter, and located 8 feet apart. They are over 100 feet deep and tap an excellent water bearing gravel which supplies a water that has a good taste and which is practically pure at all seasons. It has a slight hardness, however, that prevents its being perfect for washing purposes.

The casings for these wells comes up thru the bottom of a concrete sump, which is probably 25 feet long, 8 feet wide and 5 feet deep. Each well is equipped with a Harris air lift, using compressed air at 40 pounds per square inch.

The water station is a well-appearing single-story brick

A CORNER OF THE RESERVOIR *of the municipal water system at Wellsburg, W. Va., into which Ohio river water is pumped for settlement and distribution. the reservoir requires cleaning only once a year.*

structure with a heavy concrete foundation and floor. It is a gas-operated plant, having one 80-h.p. Riverside gas engine, using natural gas from nearby wells. This engine is connected by a clutch to a heavy jack shaft which it drives by a belt. Clutch pulleys on the jack shaft operate a 10x10 vertical Deming high-pressure triple-plunger pump. This forces the water from the sump to the reservoir, which gives a static pressure of 157 pounds. A second clutch pulley operates a 14½x10 single-cylinder Ingersoll-Rand air compressor, which furnishes the air at 40 pounds to lift the water from the wells.

A Jacobson gas engine of 4½ h.p. is used to operate the starter for the large gas engine. A single 8-inch line is laid to the reservoir. The reservoir is brick lined, the bricks being laid on a blue clay bed, and has never leaked.

About 125,000 gallons are required for the service each day. The station must be operated on an average of five hours per day to keep up the supply. Each of the several manufacturing plants has its own plant and does not use the city water, but they have high pressure water plugs. The city has seventeen of these plugs, and pays $50 per year each for them. All the service lines have meters, and the rates are as follows:

Minimum rate per quarter, $1.50.

Fifty cents per thousand for 6,000 gallons or under; 45 cents for 7,500 gallons, and down to 15 cents for 1,000,000 gallons.

So far the only trouble with the plant operation has been the cracking of the pump base, and the first type of meters had to be changed for more reliable ones.

FLAT RATE QUARTERLY WATER BILL FOR A SMALL FAMILY SERVED BY A CITY-OWNED PLANT AT WELLSBURG, W. VA.

No. 22 **Wellsburg, W. Va.** July 1st 191 5

O. S. Johnson

To WELLSBURG WATER WORKS, Dr.

Assessment from April 1st, to July 1st, 191 5

RECEIVED PAYMENT July 10 191 5

John Doe City Col. and Treas.

Rental Value $ 1.96 at 3-8 per cent			73
Persons 2 @ 12½c.			25
Bath Room " " "			25
Water Closet 1		1	25
Store			
Horses			
Carriages			
Cows			
Lawn or Garden			
Street Hose			
Boilers			
Washer			
Specials			
Total	$	2	48

SPECIAL RULES

No. 1. The use of water for any other purposes than that named in this bill is absolutely prohibited.

No. 2. Non-paying consumers are to be strictly forbidden the use of water from the hydrants of others who have paid, under penalty of having water shut off from the latter without further notice.

No. 3. All persons not paid on or before the 10th of the month will be shut off according to Rule 13, without further notice.

No. 4. Collections are made the first day of January, April, July and October.

No. 5. No hose will be charged for less than a season. Hose limited to 20 feet; 5 cents extra for each extra foot.

MONOLITHIC BRICK PAVEMENTS

By Maurice B. Greenough, Instructor in Highway Engineering, Case School of Applied Science, Cleveland, Ohio.

The monolithic construction of brick pavements has attracted so much favorable attention that this full comparison of that method of construction with those which have preceded it, and its definite classification, will be very acceptable. It is from a paper before the Ohio Engineering Society.

At the present time, the monolithic type of construction is of two kinds, both representing a breaking away from the practice of constructing brick pavements in two parts, separated by a layer of foreign material, but one more gradual than the other. In one we have no radical change in the relationship of the various elements of the structure. It differs from the sand cushion type only in the addition of cement to the cushion course, producing a part which might more properly be called a cement mortar bedding course. A union is made with the finished surface of the concrete base, but it is only such union as may be obtained by bonding a thin layer of cement mortar to a prepared concrete surface, and to the bottoms of vitrified paving brick. Such is the method of construction applied in Baltimore, St. Louis, Cuyahoga county, and to a slight extent in Cleveland, during the past two years.

The other, as typified by the newly-built roads at Paris, Ill., is a complete divorce from the old order. It represents the final step in consolidating the wearing surface and the foundation, so that both contribute their united strength to the structure. All semblance of a cushion or special bedding course is done away with, and the vitrified wearing surface is completely bonded to the green concrete base.

In that type in which the bricks are laid directly on the green concrete foundation, developed originally for country roads, but since applied to city streets, the preparation of the sub-grade differs in no respect from that of any improved road. Thoro drainage must be insured and a uniformly compacted sub-grade created as the foundation.

Steel side forms are placed in position as far apart transversely as the width of the finished roadway. They are held firmly in position, true to line and grade, by steel pins driven into the sub-grade about 10 feet apart.

A concrete mixer, supported by planking to prevent injury to the prepared sub-grade is placed in the center of the roadway, with the coarse and fine aggregate in the proper amounts deposited in piles ahead of the mixer. Whenever possible the aggregate should be placed outside the limits of the prepared sub-grade in order to prevent the risk of injury by trucking. When it is impossible to avoid dumping the aggregate on the prepared sub-grade, a layer of sheeting should be spread upon it for vehicles to maneuver upon. The cement in sacks is placed in a position convenient to the mixer.

For convenience and simplicity in operation, the mixer is equipped with a conveyor bucket traveling on a boom about 20 feet long, in order that the concrete may be deposited quickly without disturbing the sub-grade.

When the work begins, concrete of a quaking consistency is deposited from the conveyor on the sub-grade between the forms. It is then roughly struck off by means of shovels to a depth about 2 inches greater than the required depth of foundation. The concrete having been deposited, roughly struck off, and spaded along the side forms in order to allow only mortar to come in contact with them, the foundation is struck off to a true surface and luted by means of a double template, in which has been placed a dry premixture of sand and cement in the proportions of one to four. The template is attached to the mixer by a chain, fastened to each end of the template, forming a triangular hitch, from the center of which another chain passes to the mixer.

The forward motion of the template may be obtained either by driving the mixer ahead on the planking or by winding the chain on a specially prepared drum on the mixer. Of the two methods, the latter is preferable, because of the greater smoothness of pull and the lessened danger of disturbing the sub-grade.

NO CURB *laid on the Middle Springfield road, Paris, Ill., monolithic brick pavement construction.*

The character of the double template is of the utmost importance and may well be called the salient feature of this method of construction. As developed at Paris, Ill., and very successfully used there, it consists of a forward cutting edge, an I-beam, and a rear cutting edge, a channel with the flanges placed outward. The I-beam and the channel are spaced from 2 to 3 feet apart. The bottom of the rear cutter is about 3/16 of an inch higher than the lower edge of the forward cutter. With the space between the two filled with dry sand and cement, a forward motion of the template first cuts off the concrete and then fills all irregularities in the surface with the luting mixture.

Sufficient water is used in mixing the concrete so that enough will work to the surface and be absorbed by the luting mixture to insure its thoro hardening.

The surface thus created in the rear of the template is remarkably smooth, entirely free from depressions, and is ready to receive at once the brick surface. No difficulty has been experienced in laying the brick in the usual manner, having them brought

in on pallets with the best edge upward, the dropper standing upon the brick just laid. There is sufficient rigidity in the green concrete base even at this stage to resist the formation of any depressions in the surface by workmen moving about upon it. It is well, however, to have boards laid for the men to walk upon.

The brick setting is immediately followed by rolling. A light hand roller weighing from 400 to 500 pounds has been found entirely adequate to obtain a remarkably smooth surface; in fact, the surface obtained before rolling is as smooth as many sand-cushioned streets after rolling.

In agreement with the general plan of operation in the Paris construction, grouting is made a specialized operation. All new work on the road stops about an hour before closing time for the day and the whole force of men excepting those who will be noted are detailed for grouting. A few workmen remove the forms from the previous day's work and place them in position for the coming day's operations. One or two men may also be detailed for cleaning up and making such minor repairs on equipment as may be necessary, so that work may proceed uninterrupted on the following morning.

The grouted surface is allowed to stand uncovered until the following day, when it is covered with a protective layer of sand or earth, moistened to prevent too rapid drying of the concrete.

Between 400 and 500 linear feet of 10-foot roadway was the usual day's progress at Paris.

That type of monolithic construction employing the sand-cement-mortar bed thus far has been constructed by the same methods as the sand cushion type, with the exception of premixing the sand and cement in the proportions of one part of cement to three or four of sand. The cushion thus prepared is struck off by means of a template, rolled with a hand roller weighing between 300 and 400 pounds before the bricks are placed in position. The bricks are sprinkled before grouting so that moisture is added to allow the mortar bed to harden thoroly.

If we compare the two methods of building monolithic brick pavements on the basis of results already demonstrated, we find that the sand-cement-mortar type has increased the cost of construction, while that method by which the brick are placed on the green concrete base has decreased the cost of construction.

In the sand-cement-mortar bed type, the base is prepared in advance and allowed to harden exactly as if the sand cushion type were to be built. The same depth of brick is used and the same concrete edging or curb has been retained that were formerly employed. The increase in cost arises thru the introduction of the cement in the cushion material. Any saving in the amount of sand used and in allowing faster dropping of the brick is offset by the cost of the cement and the cost of premixing the cement and sand. The net result is an increased cost per square yard for the construction. In the Paris type of monolithic construction a saving is effected by the saving in materials and specialization of the various functions of construction.

Thus far, the majority of the pavements of the Paris type have been constructed on country roads whose width is between 10 and 15 feet. It has, however, been successfully employed at St. Louis at the intersection of two streets 36 feet in width. A street has also been paved in this manner within the limits of Paris, Ill. Two operations were made of striking off and luting the concrete foundation in this instance. The theory that such construction could not be adapted to city street, because of their greater width seems to be disproved

ONE DAY'S WORK *on the Middle Springfield road, Paris, Ill.*

by these demonstrations. That portion of the pavement at street intersections which could not be built by the forward motion of the template was struck off and luted by hand with good success. As an alternative method of constructing such places, it is possible to leave forms in place and to return later and strike the surface off at the proper elevations.

The sand-cement-mortar bed type has had its widest appreciation in city practice, with the exception of some 45,000 square yards laid in Cuyahoga county, Ohio, during the season of 1915. In this work the depth of the base was made the same as that for the sand cushion type and the concrete edging was retained. One of the advantages of the Paris type is found in the elimination of the curbing or edging for country roads, so that from the point of view of effecting economy in materials this type has the advantage over the sand-cement-mortar bed type.

In analyzing the monolithic construction of brick pavements from the point of view of the three interests involved, the speaker used the Paris type with the brick on the green concrete as the basis, in the belief that this is the ultimate aim of all monolithic construction.

From the Point of View of the Contractor.

Executives are agreed that the maximum efficiency in operation and organization obtain when the same men continue to exercise the same functions, in other words, specialization of effort. Effective effort on the part of workmen building a road is obtained when each man becomes thoroly familiar with the work which he has to perform and particularly if he has but one kind of work to do. In road construction the tendency to create dullness by specialized effort is offset by reasonable hours of labor, out-of-door environment, competition between other men performing other functions and proper supervision and oversight on the part of foremen and the contractors themselves. Because of the simplicity of the operations involved newcomers fit easily into the system.

Again, economy in materials, which decreases the amount of money which must be tied up during the prosecution of a contract, appeals, strongly to the contractor. A type of construction which promises to be a credit to the man performing the work and one in which the hazards of unknown and unfore-

seen circumstances are reduced to a minimum commends itself strongly to the contractor.

All of these conditions are satisfied by the Paris type of monolithic construction. The entire force engaged in building the pavement is distributed over a distance of less than 75 feet along the road, encouraging economy by making possible strict supervision of all the work. The same men perform the same operations continually. For instance, certain men are always engaged in roughly striking off the concrete base and spading it about the forms; others are mixing the sand and cement luting course and keeping the template well filled; still others are constantly bringing in brick for the droppers, and so on. Thus, the entire operation proceeds at a uniform rate of speed thruout the day. There is no confusion or loss of time by changing duties. Economy in materials is effected by the elimination of the curbing or edging in country road construction. A saving is made in the amount of sand and cement required for the luting course over what would be required for a sand-cement-mortar bedding course, or even a plain sand cushion.

No time is lost in waiting for a concrete base to harden before brick laying may commence. In other words, there is no call for equipment to be brought on to the work until actual operations of constructing the pavement begin. Of course, the sub-grade must be prepared, but except in unusual circumstances that may be going on simultaneously with the construction of the pavement only far enough ahead so that no time will be lost by breakdowns or other unforeseen delays in preparing the sub-grade.

In the use of the special template which both strikes off and lutes the concrete foundation is found the critical point in construction. No make-shift template should be employed. It should be substantial and designed particularly for the work to be performed by it. The cost of the template is very small in proportion to the economy effected by its use. For the contractor who expects to build monolithic brick pavements, the cost of attaching a winding drum to the mixer for drawing the template ahead, is also relatively small and is entirely justified by the results secured.

BRICKS REMOVED *from the pavement on the Middle Springfield road, Paris, Ill.*

From the View Point of the Engineer.

The principal defects of the sand cushion type of brick pavements have been longitudinal cracks and surface depressions, caused by soft spots or shifting in the sand cushion, by imperfect grouting or combinations of the two effects. The presence of moisture in the sand cushion which may freeze and expand during cold spells may also be a contributing factor in the formation of longitudinal cracks. One thing is certain, that the elimination of the sand cushion eliminates its hazards as well, and defects that develop must be attributed to some other course. So far, no longitudinal cracks have developed in monolithic pavements.

The opinion of engineers has been expressed from time to time that they feared that at the end of five or six years, the bricks would become broken and battered on account of the anvil effect of the base when the surface is subjected to moving loads. In the absence of any specific data to prove or disprove this opinion, recourse must be made to a pavement constructed in Terre Haute, Ind., by this method, now twelve years old.

The pavement mentioned was laid at the side of Hulman and Company's building, leading from the thorofare into the railroad yards. Thruout its life it has been subjected to heavy trucking. Originally it was provided with a stone curb at the side which for a time received the shock of loads coming diagonally upon the side of the pavement, since the entrance to the yards must be made by turning off the side and not directly off the end of the pavement.

A recent examination of the pavement by the speaker showed that the curb has been entirely disintegrated where vehicles come on to the pavement, and that excepting a slight cobbling of the exposed edge of the brick, the surface near the edge has received no injury. The entire surface of the pavement showed no defects. Such wear has occurred as might be normally attributed to heavily concentrated traffic. It may also be said that the bricks never received any rolling when they were laid.

We know that the ability of any structure to withstand the shock of suddenly applied loads depends upon the ability of the material to yield slightly and to store within itself internal energy equal to the amount of the external energy applied to produce the given state of distortion. This storage of internal energy is evidenced by the elastic recovery of the structure to its original position upon removal of the load. We commonly describe this function of a pavement as its resiliency. Just what the resiliency of a 4-inch brick surface firmly united to a 4-inch concrete base will be, is something to be determined by actual measurement.

A few measurements have been made to determine the resiliency of brick pavements by Mr. James E. Howard, of the Interstate Commerce Commission, but beyond indicating a feasible line of investigation, his results are not yet available for accurate computations. He measured resiliencies of brick pavements under a load of one-fourth a total vehicular weight of 5,540 pounds, and found them to range between three ten-thousandths and one one-hundredth of an inch, but unfortunately his report does not describe the type of construction.

There is evidence to lead one to conclude that in some instances the elastic limit of the surfacing has been exceeded in the stresses created by deflections, and, of course, under this condition no elastic recovery could take place and permanent deformation resulted.

A careful study of monolithic pavements leads to the conclusion that they are inherently stronger and better suited to withstand successive deflections without injury than is that type having the wearing surface and the foundation acting separately, the only

connection between the two being dependent upon a layer of sand which may or may not establish a contact.

A careful conception of monolithic brick pavements is reached when they are considered in the light of a brick wearing plate, well adapted to resist attrition by traffic, combined with and supported by a layer of cheaper materials, possessing qualities which adapt it admirably as a foundation.

The taxpayer's interest in improved roads lies not only in having a smooth and comfortable road over which to ride, but also in how much he must pay to secure such a road. His interest in monolithic construction is quickened by the knowledge that a type of construction for brick roads has been developed which promises to be equally and probably more satisfactory than the sand cushion type, and, as has been indicated by work thus far performed, it is secured at a cheaper price. Actual performance under many different conditions is the ultimate criterion for judging the merit of any type of construction, but in the light of what is known of pavements and other structures of similar character, an opinion that an improvement has been made that will produce a pavement of superior quality to those built with a sand cushion seems at the present time to be justifiable.

LAYING THE BRICK *on the Middle Springfield road. Paris, Ill., monolithic brick pavement construction.*

Materials Required for Road Construction

Convenient Tables for Foremen of Storage Yard and Road Work as well as for the Estimating Engineer and Contractor.

TABLE GIVEN TO STORAGE YARD FOREMAN—AMOUNTS FOR 1 MILE OF ROAD

	Pebbles			Sand			Cement		
Width of Road	Cu. Yd.	Tons	Carloads	Cu. Yd.	Tons	Carloads	Bbl.	Tons	Carloads
12 ft.	1369	1916	55	684	855	20	2396	455	13
15 ft.	1711	2395	69	855	1069	24	2995	569	16
16 ft.	1825	2555	73	912	1140	26	3194	607	17
18 ft.	2053	2874	82	1026	1383	31	3594	682	20

1 cu. yd. pebbles, 1.4 tons; 1 carload pebbles, 35 tons; 1 cu. yd. sand, 1.25 tons; 1 carload sand, 44 tons; 1 cu. yd. cement, 0.19 tons; 1 carload cement, 36 tons.

TABLE GIVEN TO MAN ON THE GRADE—AMOUNTS TO BE PLACED PER 100 FT. STATION.

Width of Road	Bbl. Cement	Yards Gravel	Yards Sand	Wagon Loads Cement	Wagon Loads Gravel	Wagon Loads Sand
12 ft.	45	26	13	4	20	10
15 ft.	56	33	16	5	25	12
16 ft.	60	36	17	6	27	13
18 ft.	68	39	20	6	29	15

Cement—45 sacks to 1 load; gravel—1 1/3 yd. to 1 load; sand—1 1/3 yd. to 1 load.

ELECTRIC POWER IN SEWER CONSTRUCTION

By Bayard W. Mendenhall, Salt Lake City, Utah.

Where electric current can be obtained at reasonable rates, and where the electric power lines parallel the work, whether of sewer or pavement building, within a reasonable distance, the flexibility of this method of power transmission is certainly to the advantage of the contractor. This article shows what has been developed in this line in a practical way on sewer work, and certainly the method is attractive in description. The fact that the current is used in the daytime should make a low rate possible, especially when the electric plant has a large lighting load and needs power load during the day to produce the highest plant efficiency.

THE Salt Lake Division of the Utah Power & Light Co. has been making rapid strides during the past two or three years in the introduction of electricity for use by contractors. The thing which has done most to make its use possible in many jobs is the introduction of the use of portable substations, one of which is shown in one photograph. One of the first contractors using electric power extensively was the Ulen Contracting Company of Chicago, on a contract in Salt Lake City, having approximately seventy miles of trenches and sewer pipe varying in size from six inches to six feet.

Practically the entire district had much water in the subsoil, the permanent water table varying from two to ten feet below the surface, and in some cases, it was a couple of inches above the surface during certain seasons of the year. The removal of this water from the trenches quickly, safely and economically, was one of the biggest problems in connection with the job. The power company's distribution lines paralleled approximately all of the trenches to be built at a distance of not more than two blocks.

The second photograph shows the discharge of an electrically operated eight-inch centrifugal pump operating in a man-hole at Tenth South and State Streets. The end of the portable sub-station supplying power is shown on the left-hand. Two pumps, one four-inch and one three-inch, were necessary at this point to handle the large quantity of water encountered. The trench is 16 feet deep and water was struck at a depth of four feet. Twenty pumping outfits, aggregating 117½ horse-power, were used on this job.

On Tenth South, where a 60-inch pipe was installed at a depth ranging from 12 to 16 feet, an electrically operating excavator was used, a cut of the hoist equipment of which is shown in the third photograph. An industrial track was laid along the trench on which this double drum hoist, operated by a 22-h.p. motor traveled. A dead man supporting the cable was located approximately 600 feet behind the hoist with a traveler operating on the industrial track between them at the point at which the excavating was being done. The hoist conveyed the buckets to the traveler, where they were lowered into the trench, filled, elevated and carried back and dumped beyond the point where the pipe had been completed, thus filling the trench. This outfit proved to be far more satisfactory than a similar steam equipment which was tried, due principally to the fact that the high speed steam engine shook the platform excessively. The cost of operating was considerably less, together with all the advantages of electric versus steam power.

Electric power was also used extensively by W. M. Gibson in the work which he did on West Third, Fourth and Fifth North Streets, Salt Lake City. Here the quantities of water to be handled were less than on the Ulen job. For that reason diaphragm pumps, both single and double mounting, were used, as they are better adapted for this purpose.

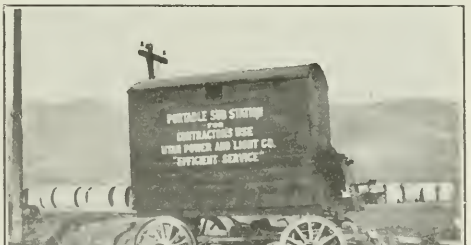
One photograph shows one of these equipments; a double diaphragm pump driven by a 3-h.p., 3-phase motor mounted on skids for easy handling. No electrically operated diaphragm pumps were regularly made so far as could be determined and the outfit here shown was developed for this purpose and its operation was entirely satisfactory. The outfit handles readily 100 gallons per minute. It has the advantage that it does not require repriming in case the water in the pump is exhausted, as do centrifugal pumps. Four 3-inch double-diaphragm and three 4-inch single-diaphragm pumps equipped as above, as well as one 3-inch centrifugal pump, were used on this job.

The latest and most extensive application of electricity to this kind of work is to be found in the contract recently awarded to Gibbons Bros., Reed & Roche for the construction of an intercepting sewer extending from Ninth North and Eleventh West to Tenth South and Seventh West, a distance of approximately 18,000 feet or 3.4 miles.

A sectional concrete pipe will be installed, the inside diameter ranging from 60 inches at its upper end to 78 inches at its outlet. This sewer pipe will be laid in a trench varying in width from 8 feet at its upper end to 11 feet at its outlet, with an average depth of 20 feet. The digging of this trench will require the removal of 150,000 cubic yards of earth. The northern end of the ditch passes thru a district containing underground water.

After studying carefully several different methods of handling the excavating of this trench and the laying of the

PORTABLE SUB-STATION *used to supply electricity of proper voltage to sewer construction machinery. Note reinforced concrete pipe sections in the background.*



ELECTRICALLY DRIVEN CENTRIFUGAL PUMP *taking water from man-hole in 16-foot trench. The portable sub-station is at the left in the background behind the line pole.*

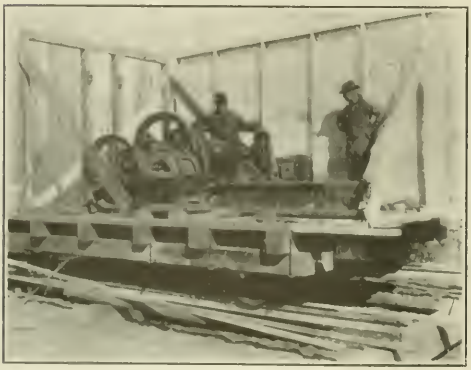
pipe, Gibbons Bros., Reed & Roche decided on the exclusive electric equipment herein described.

The Utah Power & Light Company had primary lines along the route of this sewer for most of its length. As the city will build a pumping plant at its terminus to lift sewage to the elevation of this gravity sewer outlet, the company built its transmission line along the sewer to its terminus for the remainder of the distance, which line is used to serve the excavating equipment. Two portable substations, each equipped with three 50 k.w. transformers are supplied, the one being used as a spare to be connected up ahead of the work, while the other is in service. Secondary cables consisting of two 400,000-circular-mill cables are run out from the substation a distance of approximately 800 feet either side. These cables are made up in lengths of 100 feet and are connected together by means of junction boxes at which points the various pieces of apparatus are connected to the secondary feeder as they move along the ditch.

The ditch is excavated to a depth of approximately 5 feet by means of horse-drawn scrapers. Beyond this depth it is not economical to use them. Sheet piling is then driven down using a pile driving traveler, which is seen in the foreground of the fifth photograph. This crane is equipped with two W-1 and two S-1 Sprague electric hoists. The two forward ones are of one-half ton capacity and handle the interlocking sheet steel piling. The two rear ones are of one-ton capacity and handle the compressed air hammers, which are used in driving the piling. These hoists are rope-controlled from the ground. Compressed air for operating the hammers is furnished by an Ingersoll-Rand compressor of 400 cubic feet free air capacity belted to 75-h.p. General Electric motor. This compressor outfit is mounted on a truck and wheeled along an industrial railway beside the trench as needed. The ¾-yard grab-bucket gantry cranes follow behind the sheet piling crane and do the excavating. One of these cranes is equipped with an orange-peel bucket, the other with a clamshell bucket. The former

DOUBLE DIAPHRAGM PUMP *electrically driven, pumping water from sewer trench, Salt Lake City, Utah.*

ELECTRIC HOIST *of sewer trenching machine on carriage spanning the sewer trench.*

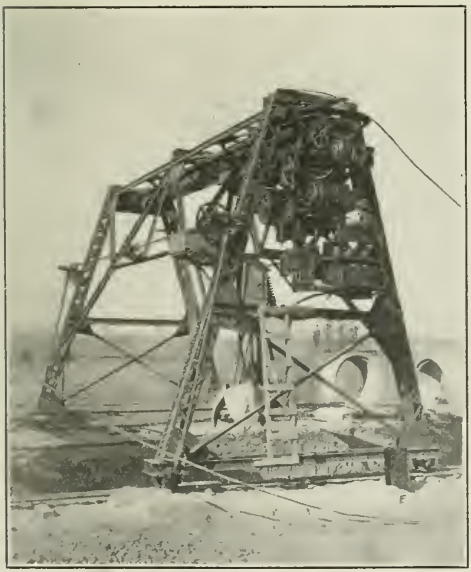


one is shown in the sixth photograph. These electric shovels, as well as the pipe-laying crane described later, were made by the Sprague Electric Works of the General Electric Company. Each of the digging cranes is equipped with four hoisting motors: A 10-h.p. motor operates the holding cables; a 22-hp.p motor operates the drum which closes the bucket, called the lacing motor; a 6-h.p.motor operates the cross travel of the carriage, and a 10-h.p. motor operates the longitudinal travel along the track.

At the present time the dirt is being hauled away from the excavators in horse-drawn carts, but it is hoped to work out some more efficient way of handling this feature. After the excavation is completed the pipe-laying crane picks up the lengths beside the trench and places them. This crane, shown in the last photograph, is equipped with a 30-h.p. hoist motor, a 5-hp.p. trolley motor and a 10-h.p. traction motor.

TRAVELER WITH ELECTRIC MACHINERY *spanning sewer trench. In foreground sheet piling is handled and driven by two electric hoists on two small travelers. In the rear are the digging and pipe-laying cranes with hoists for handling the orange-peel or clamshell buckets and the sections of pipe to be laid. The portable sub-station is seen on the right.*

NEAR VIEW OF DIGGING CRANE *showing the electric and hoisting machinery, the clam-shell bucket and the method of moving the traveler along the trench.*



The electric equipment includes four vertical-shaft centrifugal pumps directly connected to $7\frac{1}{2}$-h.p. motors which will be used in pumping water from the trench where needed. The aggregate connected load on this job is 265 h. p.

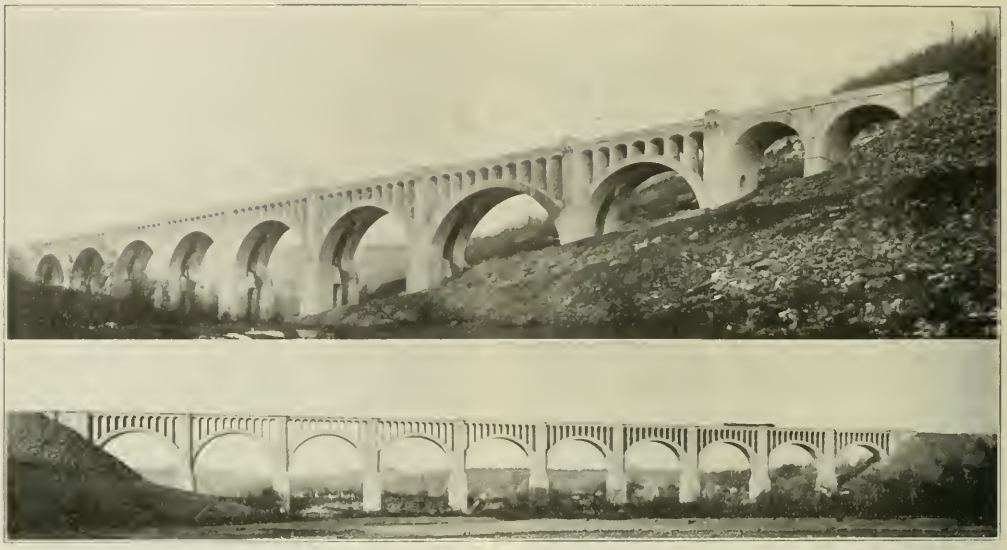
It is a little too early to get reliable information as to the current consumption per cubic yard handled, owing to the fact that the machinery is still stiff and the operators are inexperienced, but, all things considered the equipment is proving to be all that the contractors expected of it. They are confident that they will be able to do the job more economically than they figured in their estimates on which their bid was based. The power company estimated a revenue of $5,000 from the job, and the preliminary indications are that this estimate will be not far from correct.

NEAR VIEW OF THE PIPE-LAYING CRANE *showing electric hoist and a pipe on its way to the bottom of the trench.*

Lectures on Military Engineering

As a preliminary to service in a proposed reserve corps of engineers, a course of seven free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-General Leonard Wood, and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty.

Thru the cordial attitude and co-operation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. The lectures began on Monday, February 14, and continue thru February and March.



THE COMPLETED VIADUCTS. ABOVE: THE MARTINS CREEK VIADUCT. BELOW: THE TUNKHANNOCK VIADUCT.

CONSTRUCTION METHODS ON VIADUCTS

OF THE LACKAWANNA RAILROAD OVER TUNKHANNOCK AND MARTINS CREEKS

By C. W. Simpson, Resident Engineer, D. L. & W. R. R., Columbia, N. J.

The general features of these two rather spectacular viaducts on the new cut-off of the D., L. & W. R. R., to save a little distance and grade, are very familiar from frequent description and illustration. This article on the methods of building them used by the engineers and contractors treats the subject on the practical side and is of special value on that account. It is from a paper before the American Concrete Institute.

TWO large concrete structures, known as the Tunkhannock and Martin's Creek viaducts, have recently been completed by the Delaware, Lackawanna & Western Railroad Company, in connection with a grade improvement between Clark's Summit and Hallstead, Pa. Following is a brief outline of the structures, pointing out a few of the more essential features of the planning and carrying out of the work of construction

Martin's Creek Viaduct.—The Martin's Creek viadust is a three-track bridge having a maximum height above stream-bed of 150 feet and a length of 1,600 feet. It has two 50-foot and two 100-foot semi-circular arches, and seven 150 by 59-foot three-centered arches. The larger arches are 6 feet wide, spaced 29 feet 6 inches center to center, which carry transverse spandrel walls supporting an arched floor system. This structure required about 26,000 cubic yards of foundation excavation, 77,000 cubic yards of concrete and 1,600,000 pounds of reinforcing steel. The completed bridge is shown in an accompanying photograph.

Tunkhannock Viaduct.—The Tunkhannock viaduct is a two-track bridge composed of ten 180-foot and two 100-foot semi-circular arches springing from solid piers and supporting transverse spandrel walls, upon which rests a floor system composed of 13-ft. 6-in. semi-circular spandrel arches. The deeper piers have a section 40x46 ft. below the ground surface and all piers are 36 ft. 6 in. by 43 ft. 6 in. to a point 17 feet below the springing line of the main arches. At this elevation a 4-ft. 3-in. offset provides a seat for the temporary steel centering. The deepest pier extends 103 feet below the original ground surface, and at this pier it is 309 feet from the bottom of the foundation to the highest point of the masonry. Each main arch is composed of two ribs, 8 feet thick at the crown and 14 inches wide. About 163,000 cubic yards of concrete, 2,500,000 pounds of reinforcing bars, and 48,000 cubic yards of foundation excavation were required. All piers were carried to solid rock, the depth of which had been determined by borings. The completed bridge is shown in one of the photographs.

The natural conditions at the site of each of these structures and the method of carrying out the construction work (with one exception) were so nearly identical that a description of the Tunkhannock viaduct will apply equally as well to the Martin's Creek. The exception noted is that the Martin's Creek bridge was constructed entirely with derricks, while at the Tunkhannock bridge both derricks and a cableway were used. The reason for the use of a cableway at the latter structure was its height and the length of the spans.

GENERAL PLAN OF PROCEDURE.

The contract for this work was let in June, 1913, and the time set for completion was July 1, 1916.

In planning the work no detailed schedule was laid out, but the following general plan of procedure was determined upon.

Of the thirteen foundations, six were more than 40 feet deep, and steel sheeting was adopted for these six excavations. At three of these and at three of the other foundations, the configuration of the ground was such that a portion of the excavation could be accomplished with a steam shovel. Of the other three deep foundations, two were partly in the bed of the stream and were considered to be the most difficult. It was decided to provide sufficient sheeting for these two piers; to start them at the earliest possible date: and to re-use this sheeting at the other four deep excavations. In the meantime the steam shovel excavation was to be carried out and the other shallow piers excavated.

In planning the concrete schedule it was necessary to consider that the mixing plants would be on low ground, while five of the shallow excavations were in much higher ground and could be reached economically only by the use of the cableway. For this reason, no large amount of concrete could be placed until either the cableway or some of the deep foundations were completed. It was estimated that of the excavations accessible without the cableway, four (two shallow and two deep) could be completed on or before January 1, 1913, and the concrete schedule was made out from that date, as the cableway could not be ready for use before February.

These conditions made it necessary to contemplate the placing of 163,000 cubic yards of concrete in thirty months. It was, of course, recognized that concreting could be carried on much more rapidly and continuously while working on the foundations and on the main pier shafts than would be the case when working on the arch rings and spandrel system. About half the concrete, or 80,000 cubic yards, is below the springing line of the main arches, and it was decided that this quantity must be placed during the first ten months, or at the rate of 8,000 cubic yards per month. This made the rate for the remaining twenty months 4,200 cubic yards per month.

It must not be understood from this that it was the intention to complete all the work below the springing line before proceeding with the superstructure. On the contrary, it was desired to combine work on the superstructure with the part below the springing line as much as possible; but it was realized that the pier work must predominate during the first third of the allowed time. Also, it was not expected to maintain a uniform monthly rate. The schedule was simply a general guide as to the sufficiency of the plant and forces engaged.

The organization of forces was as follows:

A general manager was in complete control. To him reported a superintendent and an office manager. A timekeeper and a material clerk reported to the office manager regarding office matters and to the superintendent regarding field matters. The superintendent's assistants were as follows: Master mechanic, general carpenter foreman, foreman rigger, foremen of concrete gangs, foremen of excavation gangs, mixer foremen, foreman of material gang and foreman of steel gang. The master mechanic was in charge of all machinists, enginemen, hoist runners, cableway runners, steam shovel men, pumpmen, drill runners, blacksmiths, signal men and electricians. The carpenter foreman had under his direction subforemen, mill-men, carpenters and helpers. The rigger foreman was responsible for the condition of the cableway and derricks. The duties of the other foremen are evident from their designation. Laborers and sometimes foremen were shifted from one class of work to another as occasion demanded, but all men were kept at the same work so far as possible.

GENERAL LAYOUT.

Before the completion of the improvement the main tracks of the Delaware, Lackawanna & Western Railroad were approximately parallel with and about 450 feet distant from the viaduct. The railroad company's tracks were on an embankment, so that they were about 60 feet higher than the creek bed and about 35 feet higher than the ground level at the mixing plants. The loop formed by the narrow gage track encloses a knoll about 30 feet higher than the general level of the valley. On this knoll are located the machine and blacksmith shops, superintendent's office and water tower. The general office and hospital are located on ground at about the same elevation as the knoll above mentioned. The general material derrick is located on a narrow ridge which connects the railroad embankment with the knoll at the blacksmith shop. A similar ridge extends from pier 6 to the high ground at the hospital. Cuts were made thru these ridges to permit the laying of the 3-foot gage tracks.

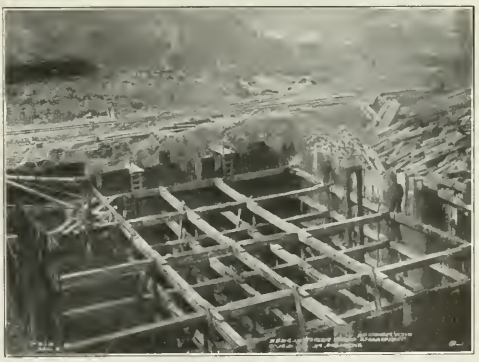
The first operation was the widening of the railroad company's embankments and the laying of track for empties and loads. This track was completed on June 12; a track pile-driver immediately started to construct the material trestles; the general material derrick was erected; work was commenced on the shops, storehouses and office buildings, and a narrow-gage track was laid from the material derrick to pier 4. During July a steam shovel started foundation excavation, and sheet piling was being driven at pier 4. During August the erection of the cableway was started; a trestle carrying a narrow-gage track was built across the creek to give access to pier 3, and a large amount of plant and supplies were delivered on the ground.

FOUNDATION EXCAVATION.

A steam shovel having a 1-cubic-yard dipper excavated piers 5, 6 and 8 down to ground-water level and piers 2, 9 and 10 down to rock. The material was allowed to take its natural slope, and the excavations were made sufficiently large to take care of the raveling of the banks prior to the completion of the piers. The shovel loaded the material into 4-cubic-yard cars, and it was utilized in grading for the narrow-gage tracks and in bringing all low ground between the creek and the railroad up to a level with the mixing plants. All the ground around the sawmill, laying-out platform, steel rack, boiler house, and mixer 2 was "made" in this way. This "leveling up," amounting to as much as 12 feet in some places, was done at practically no extra cost and proved a very great benefit in handling the work. The shovel completed its portion of the excavation in December, 1912, having excavated about 50,000 cubic yards, 15,000 cubic yards of which was pay material.

In excavating below water level, interlocking steel sheet piling in length of 30 feet were used. The sheeting was driven with a 3-ton steam hammer and was braced with 12x12-inch

PIER FOUNDATION *for Tunkhannock Creek viaduct of the D., L. & W. R. R. at Nicholson, Pa.*



METHODS OF CENTERING *and of supporting Centers and Forms.*

ABOVE: *Centering and supporting of centering on the Paulinskill viaduct, where similar methods were used. The various stages of forms for constructing the arch rings are shown also, from the placing of the outside forms, on the right, to their removal, toward the left. At the far left are seen the forms for constructing the secondary arches.*

CENTER: *Two styles of centers for arches used on the Tunkhannock Creek viaduct, one of steel for a* 180-*foot span and one of wood for a smaller end span with high pier.*

BELOW: *Arch center and frame used on the east end arch of the Martins Creek viaduct.*

timber. Sheeting was required for depths of from 50 to 75 feet, necessitating the use of two and three lengths of sheeting.

The method of procedure with the excavation was to erect one set of sheeting on lines about 3 feet outside of the required foundation area, and to drive the sheeting as far as convenient. The excavation was then carried down to the bottom of the sheeting by means of 1½-cubic-yard clam-shell buckets, operated in the bays between the timber braces, which were so spaced as to admit the operation of the bucket. The bracing was put in on about 5-foot centers, vertically, as the excavation proceeded.

After the excavation had been carried down to the temporary bottom of the sheeting, the latter was driven farther, and the operation was repeated until the top of the sheeting was down to the ground surface. Another set of sheeting was then erected about 6 feet 6 inches outside the first set, and was driven as deep as was thought advisable. The material between the two sets of sheeting was excavated with the clam-shell bucket; the first sheeting was then driven farther; and the excavation was resumed. As the inside set of sheeting was driven down, the upper set of timber bracing was removed and placed at the bottom. The process was continued until bedrock was reached. Almost all of the sheeting was recovered, some of it being used four times.

Two of the piers gave serious trouble on account of quicksand. The difficulty was overcome in one of these by dividing the last 12 feet of the excavation (the total depth was 62 feet) into three pockets and taking each pocket down separately. A somewhat similar plan was tried in the other excavation but was not successful, and it was necessary to resort to compressed air. A caisson was built inside the sheeting with its cutting edge 45 feet below the top of the excavation and 32 feet above bedrock. The two lower sets of bracing timbers were built into the caisson and were carried down with it. Concrete was placed on top of the caisson as it sank in the usual manner. Had it not been for the difficulties that had to be overcome in excavating for this pier, the work would have been completed well within the contract time. This excavation was not completed until February, 1915, and yet the entire bridge was completed in September, less than three months later than the contract time.

CONCRETE PLANT.

Sand and stone were delivered on the material trestles in bottom-dump hopper cars and dumped into the storage piles. Each mixing plant was served by two derricks which operated clam-shell buckets of 40-cubic-foot capacity. These derricks conveyed the sand and stone from the storage piles to small bins over the mixers. From these bins the material passed by gravity into a measuring hopper where the cement was added. From the measuring hopper the material passed by gravity into a 2-cubic-yard mixer, which dumped directly into double-line bottom-bump buckets on flat cars. Twelve-ton locomotives hauled trains of three flat cars, one car being empty to receive the empty bucket from derrick or cableway. At mixer 1 the cement was conveyed from the original cars on the material trestle to the hopper floor of the mixer by the sand derrick. At mixer 2 the cement was unloaded from the cars into chutes, which conveyed it to the hopper floor. All cement was shipped in cloth. A cement house of 3,000 barrels capacity was built and filled, but no cement was used from this source except when shipments were delayed and no cement was available in cars.

The mixing requirements made it necessary to turn each batch from 2 to 2½ minutes and limited the mixer output to an average of seventeen batches per hour. Each mixer gang consisted of one foreman, two derrick operators, one mixer runner, one fireman and eleven laborers. Two trains, each requiring one engineman and one laborer, served each mixer. One foreman with from eight to sixteen laborers spread the concrete in the forms. The above organization, with the addition of cableway runners and signal men, averaged about 30 cubic yards of concrete per hour.

The following table gives the cubic yards of concrete placed during each month. It is interesting to compare this with the original schedule.

	1913	1914	1915
January	8,410	3,400	2,000
February	5,740	2,260	5,130
March	4,520	1,460	5,620
April	6,630	5,090	4,010
May	7,190	3,270	3,200
June	13,890	4,010	3,400
July	12,150	4,770	4,000
August	8,810	4,450	1,800
September	3,820	4,910	
November	3,270	4,310	
December	2,160	4,000	

About 8,900 car loads of sand stone and cement were

handled on the material trestles and 1,200 car loads of other material were handled by the general material derrick.

DERRICK AND CABLEWAY.

Derricks were operated by three-drum, 8¼x12-inch hoisting engines with swinging gear attachments. Masts were about 90 feet and booms 85 feet long. In a few cases derricks were erected on timber pedestals or pile clusters about 25 feet high, but in most cases they were set at the ground level, and all work above their reach was carried on by means of the cableway.

The cableway consisted of two lines of 2¼-inch main cables, spaced 20 feet apart and supported by end towers about 160 feet high and an intermediate tower 300 feet high. The end towers were 3,028 feet apart and the intermediate tower divided this distance into two spans of about equal length. Four engines and carriages operated as four independent units. The towers were of timber and the intermediate tower was so located and designed that the arch rings and all the floor system except a narrow slot, could be constructed thru it and thus utilize the cableway to the fullest extent.

The last centers to be erected were those passing thru the center tower. The adjacent piers were carried up to the top of the floor before these centers were erected and two stiff-leg derricks were located on each pier. After these last centers were erected, all material was raised above them by the derricks and then transferred to the cableway for transportation to its destination.

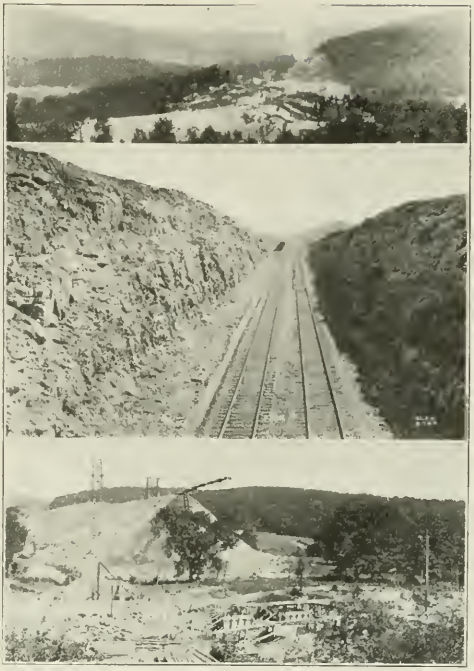
ARCH CENTERS.

Five sets of three-hinged steel arch centers were used in constructing the 180-foot spans. Each set was composed of four ribs weighing 47 tons per rib, spaced 3 feet 10 inches center to center, and provided support for one of the two concrete ribs composing each span. A 4-foot 3-inch ledge or offset, 17 feet 6 inches below the springing line of main arches, was provided to support the centers. On this offset rested an I-beam grillage extending the full width of the pier and carrying 6-inch rollers on which the pedestals of the centers rested. For erection purposes each steel rib was built in four sections.

Before the centers were erected the adjacent piers were constructed to an elevation about 37 feet above the spring line, forming what is termed the "umbrella." The procedure of erection was as follows: After the I-beam grillage, rollers and pedestals were in place, the lower quarters of the ribs were raised to position, the bottom pins driven and the top of the sections anchored to the "umbrella" tops by bolts passing thru the concrete. One of the upper quarters was next raised to position and bolted to the quarter already in place. The other upper quarter was then put in position, bolted to its lower section and the crown pin driven. The ribs were so designed that the half rib would support itself as a cantilever. Fig. 6 shows two sets of centers in place and the lower quarters of another set erected. Fig. 5 shows the upper quarters being erected thru the center tower.

To provide for striking the centers or adjusting the crown elevation, the first panel on each side of the crown pin was constructed with pin connections, and the web member at right angles to the chords consisted of two parts connected by a right-and-left thread screw operated by a lever and ratchet. By lengthening or shortening this member the distance between the crown and end pins was decreased or increased, thus lowering or raising the crown.

After serving their purpose under one rib of a span, the centers were slacked off and jacked over to their position under the twin rib. When the span was completed, the centers were rolled back under the opening between the concrete ribs and transported to their next point of service. In constructing the last two spans, centers were erected under both ribs simultaneously in order to hasten the completion. Timber centers



VIEWS *showing the extent of cuts and fills where they were chosen instead of viaduct construction.*

ABOVE: *The Lubber Run and Wharton fills, looking west.*

CENTER: *The Van Horn cut, looking east.*

BELOW: *The east end of the Pequest fill at Andover, N. J. Note the railway track supported by cables, onto which cars are backed by con motive and there dumped.*

resting on a timber tower were used for the 100-foot spans. The type of construction of these centers is shown in the right-hand span in the photograph of Tunkhannock viaduct in the group showing the various methods of supporting forms in use on the two viaducts, which also shows the placing of lagging on a set of steel centers.

FORMS.

With very few exceptions the forms were built on the ground in sections and hoisted to position by cableway or derrick. These sections were re-used a great many times, some of the first ones built being still in service at the end of the work. To illustrate the construction and utility of this type of form a description of the forms used for the main pier shafts will be given in some detail. These sections were of two sizes, one being 18 feet 3 inches and the other 15 feet 8 inches long, and both were 17 feet 9 inches high. The larger section weighed about 7,000 pounds. Four of the larger and six of the smaller sections were required to surround one pier and were termed a set. Four sets sufficed to construct all the piers up to the centering ledge without in any way retarding the progress of the work and, with slight alterations, these same sections were used up to the tops of the piers and also as spandrel wall forms.

Each section is made by nailing two layers of 1x8-inch

tongue-and-groove boards to 8x10-inch horizontal studs spaced 2 feet 5 inches on centers, one layer being at right angles to the other and both layers at 45 degrees with the studs. The studs were bolted to 10x10-inch verticals which extended about 2 feet above the planking. All forms were faced with No. 26 galvanized sheet iron and, in some cases, paper was laid between the layers of boards as an aid in protecting the concrete during freezing weather. The forms were kept in position by rods running down at an angle of 45 degrees from the vertical posts to anchors in the concrete and by 12x12-inch timbers resting on the top edge of the planking and wedged against the verticals. The rods were provided with a threaded sleeve joint so that the projecting end could be removed from the concrete.

Six carpenters with two cables or one derrick would remove and re-erect one set of forms in somewhat less than two days. On two occasions when the plant was available and it was desired to move the forms with as much speed as possible, sixteen carpenters, with the aid of two derricks and two cables, removed and re-erected a set of these forms in seven hours.

The forms for the arch rings were very similar in construction to the pier forms, and two sets, that is, forms sufficient to cover two complete ribs, sufficed for the entire work.

The main arches were constructed with large blocks or vouissoirs separated by small keys. The block forms were made entirely separate from the key forms.

These structures were designed and built under the direction of Mr. G. J. Ray, chief engineer, and Mr. F. L. Wheaton, engineer of construction. Mr. A. B. Cohen was in charge of the design and the writer was resident engineer in charge of the construction of the Tunkhannock viaduct.

The contractors were Flickwir & Bush, Inc., for whom Mr. F. M. Talbot was general manager and Mr. W. C. Ritner, superintendent.

RAILWAY IN BRICK HIGHWAY CONSTRUCTION

The use of a standard-gage temporary track to assist highway construction has been the subject of successful experiment by contractors Swank and McIntyre in building six miles of brick highway from New Lexington in the direction of Somerset, O. All materials were hauled directly onto the job, including screened gravel, sand, cement and brick. One thousand cars were handled in the course of these operations. Thus there was only one handling of the material after it was loaded at the various supply points.

A 50-ton geared steam locomotive was used to pull the cars over a spur built entirely upon new right-of-way. The track, which is standard gage, was constructed with 60-pound relay rails. Sixty per cent. of the ties are railroad unspiked discards and are used only to furnish bearing. The remainder are standard ties which hold the gage.

Some trouble was anticipated, due to the possibility of the track settling on new fills. As a result, the ties on the fills were spaced closer and 3 or 4-inch saplings were placed under the ties parallel with the rails. However, the fills are few and all are short. The track is laid just outside the limits and parallel with the curb of the new road.

A number of 4, 5 and 6 per cent. grades are encountered.

For the concrete work a train, consisting of one car of screened gravel, one car of sand and one of cement, was kept moving alongside the Koehring paving mixer. The original intention was to use a tank car for hauling water for the concrete work, but owing to the heavy grades it was decided to pipe the water and thereby relieve the work of the locomotive.

The gravel car was spotted directly opposite the mixer. A batch hopper was hung on the side of the car and is loaded while the mixer skip is discharging into the machine. When the skip is lowered to the ground a gate in the batch hopper is opened and gravel is shot into the skip. The sand car is pushed ahead of the gravel car, and sand is unloaded thru a chute into wheelbarrows. The cement is unloaded from the cement car and distributed along the line of the work. One man is kept busy dumping cement into the skip.

The cars of brick are unloaded by carriers and laid directly from the car. High speeds are not needed and considerably fewer trips were necessary than with other common methods of transportation.

The following table indicates a haulage cost of 12 cents per ton-mile:

TOTAL AND TON-MILE HAULING COSTS.

First Cost—		
New hardwood ties, 4,000 at 32 cents	$1,280	
Old ties from railroad, 12,000 at 10 cents	1,200	
Relay rail, 60-pound, 550 tons at $17	9,350	
Labor laying and removing track, 32,000 feet 15 cents	4,800	
Locomotive	4,500	
		$21,130
Operation, 8 months at $250		2,000
		$23,130
Salvage—		
Scrap rail, 550 tons at $13	$7,150	
Locomotive	1,500	
		8,650
Net cost		$14,480

One thousand cars or 40,000 tons hauled an average of 3 miles equals 120,000 ton-miles. Cost per ton mile, 12 cents.

TRANSPORTING PAVING MATERIALS *direct from cars to pavement. Road at New Lexington, O.*

Illustrations courtesy Engineering News.

WORKERS IN THE FIELD

The Lorimer Bridge, Piqua, Ohio

Following the disastrous floods in 1913 thruout the Miami valley, several bridges in Miami county were found to be so badly damaged that reconstruction was almost impossible and efforts were made to have at least two bridges constructed of cement. Public opinion at the time was against such a construction, but through the efforts of Mayor G. W. Lorimer of Piqua, the county commissioners were finally interested in the construction of a concrete or cement bridge.

After much effort by the mayor and other public spirited citizens rough plans were drawn by Mayor Lorimer for the construction of such a bridge and the plans were submitted to the Hackedorn Contracting Company, of Indianapolis, Ind. The plans were immediately approved and recommended as being the best possible for the location of the bridge at Union street.

The bridge as recently completed over the Great Miami river, is shown in the accompanying photograph and is one of the most artistic concrete bridges in the country. It is approximately 600 feet long, comprises four arches, and has a width of 50 feet. It is all concrete including electric lamp standards. All of the railing and ornamental work above the coping are made of cast concrete, using as an aggregate, marble grit, ground marble and Medusa White Portland Cement.

At night the bridge is illuminated by large tungsten lights, and the white texture of the ornamental work stands out strongly both day and night.

LORIMER AVENUE BRIDGE, *Piqua, O., an artistic reinforced concrete bridge with concrete railing and ornamental work.*

Specification for Four-Inch Granite Paving Blocks

To Editor of MUNICIPAL ENGINEERING:

Sir—For several years past the city of Chicago has been laying granite blocks only 4 inches deep, and has gotten very satisfactory results.

It seems to us that they are following a well known engineering principle, viz., using no more material for a given service than the service actually demands, allowing a sufficient factor of safety. In street paving there are two factors to be considered, viz.,'the foundation and the wearing surface. The use of the old deep granite block was an attempt to combine both in one, and was bad engineering. Nowadays no engineer thinks of putting down a pavement without providing an adequate concrete base, and having done this, it should be his care and study to provide a wearing surface that will be as nearly permanent as possible, and with as little waste of material as possible.

It must be evident to any one that a wearing surface 4 inches thick of granite having a reasonable degree of toughness and compressive strength meets every requirement, and if a block of greater depth is used part of it may be considered as belonging to the foundation. In this case, use for foundation purposes is being made of a high priced material, whereas concrete, which is much cheaper, would answer as well.

In the field of mechanical engineering bearing or wearing surfaces are supplied with comparatively light removable bushings of high grade material which can be renewed when they wear out without disturbing the heaving casting of cheaper material which goes to make up the bulk of the machine. That is good engineering. Why not apply the same principle to road engineering, and use the following specification for heavy or light traffic streets?

The paving blocks shall be of medium grained granite, free from an excess of mica or feldspar, showing an even distribution of constituent minerals, of uniform quality and texture, showing no seams or evidence of disintegration, and a crushing strength of not less than 30,000 pounds per square inch, and a factor of toughness of not less than 12, as determined by the methods employed at the United States Department of Agriculture, Office of Public Roads.

The blocks shall be of the following dimensions: 3¾-in. to 4¼-in. wide, 3¾-in. to 4¼-in. deep, and 7-in. to 10-in. long. The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be

laid with joints not exceeding $\frac{1}{2}$-in. in width at the top and for 1-in. downward therefrom, and not exceeding 1-in. in width at any other part of the joint. The top surface of the block shall be so cut that there will be no depressions measuring more than $\frac{3}{8}$ of an inch from a straight edge laid in any direction on the top and parallel to the general surface thereof.

Not more than one drill hole shall show on the head of the block and none on the ends. An allowance of not over an average of one block showing drill hole on the side, will be permitted to a square yard of pavement.

That would provide a wearing surface of great durability, and one that can be replaced economically if it were found desirable to do so at the end of 25 or 30 years' service. A block of that size can be cut economically, and have close joints and smooth heads. It would cost less than the larger block and would produce a smoother pavement.

Of course, attention must be paid to the physical properties of the granite used, or the whole purpose would be defeated. A granite that is structurally weak is no better for paving purposes than a vitrified brick. This feature, however, can be taken care of by drawing suitable specifications.

The old specifications which called for a deep block were based on the assumption, we presume, that almost any kind of material classed under the general name of stone might be used, regardless of its physical properties. Would it not be well to draw an alternate specification, allowing the use of a block of $3\frac{3}{4}$ to $4\frac{1}{4}$ inches, provided the granite has a toughness of not less than 12 and a compressive strength of not less than 30,000 pounds per square inch, and take bids under these specifications as well as under the present standard specifications.

THE HARRIS GRANITE QUARRIES COMPANY,
Salisbury, N. C.

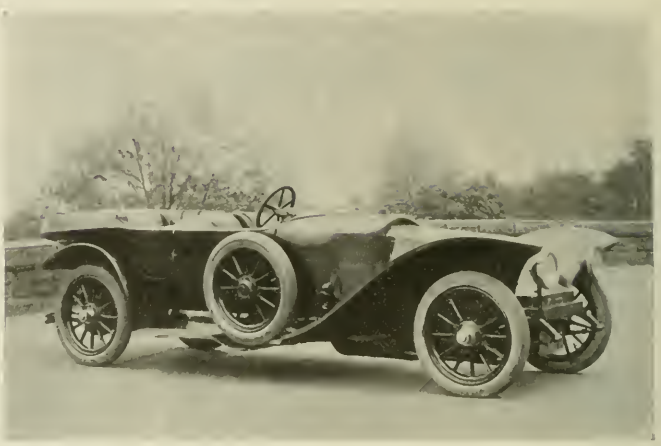
This Bid Was Not Legal

The Editor of MUNICIPAL ENGINEERING:

Sir—In the current issue of your magazine you publish a few paragraphs under the caption "Is the Bid Legal?", calling attention to the awarding of a contract by the city council of Iowa City, Ia., to William Harrabin, who offered to construct a bridge for $500 less than the lowest bidder for the contract. Since you ask the question "Is the bid legal?", perhaps you will be interested to know that in January, 1915, the city of Cumberland, Md., received a similar proposition in connection with an offering of an issue of $150,000 paving bonds. A number of bids were received from bond houses, the highest being an offer of 99.31 for the bonds. One of the bond houses, in addition to submitting a bid of 98 for the issue, made an alternative bid, in which it agreed to pay $1.00 per bond more than any other bid or combination of bids made to the city. This alternative bid was accepted by the city, over the protest of the other bidders, who asserted that it was illegal. A taxpayer's suit was brought by Henry Shriver, attacking the bid and the award on the bid as illegal and seeking to enjoin delivery of the bonds. In an opinion handed down by Judge Henderson, at Cumberland, Mr. Shriver's contentions were upheld and a permanent injunction restraining the delivery of the bonds was granted.

The Iowa City, Ia., case seems to involve exactly the same question as that thrashed out in the Maryland courts and this letter may, therefore, be of interest to your readers.

THE BOND BUYER, SANDERS SHANK, Secretary,
New York City.



MOTOR CAR *with concrete body.*

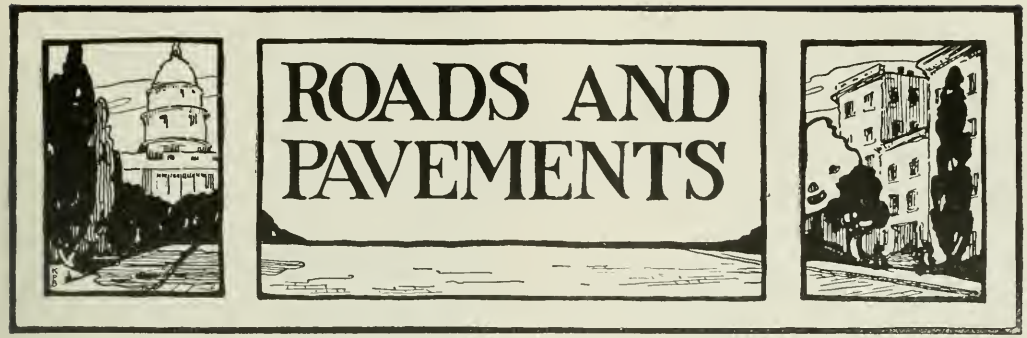
Renault Touring Car With Concrete Body

The Renault 50-horse power, 6-cylinder touring car shown in the accompanying illustration is distinguished by a concrete body, which the makers say will resist wear and retain its beauty far better than wood or metal.

The car is the most powerful and speedy built by the well known firm of Renault in their famous factory in France, and is very light and strong. It has created a great deal of interest not only among the auto manufacturers, but also with the buyers in New York, and is the only one of the kind ever received in this country.

The body construction is very novel as the coachmakers have used cement or concrete laid on wire netting or lath similar to that used in concrete building construction. The lines are graceful and no seams or joints can be found in the whole body. The dash and moldings are the only parts constructed of wood. Another striking feature is that the top completely disappears inside the body. The cushions are specially designed, with elastic supports, and are stuffed with eiderdown.

This clearly indicates that the value and possibilities of concrete construction are still undeveloped to a large extent.



Influence of Permanent Roads on Motor Truck Haulage

By S. M. Williams, Sales Manager The Garford Motor Truck Company.

The day is past when the motor truck is looked upon as an experiment. Its value in the delivery of road materials has been proven beyond any doubt, but its selection should be surrounded with every consideration. Unfortunately it has not proven practical or economical in some cases, but in the majority of these the blame was upon the purchaser and sometimes an overzealous salesman, rather than the motor truck. The same size or capacity of truck will not work successfully under all conditions. Consequently the capacity which determines the weight must be considered along with general road and bridge conditions over which the truck will be required to operate.

Again, the loading facilities are not given proper consideration, and frequently the motor truck is operated with the same loading methods as formerly employed in team hauling. The regularity with which the motor truck is operated determines its economy. Consequently loading facilities should be provided, so that little time is lost and the truck kept in as nearly continuous motion during the working hours as possible.

The motor truck, under proper conditions, is reducing the team haul cost from one-third to one-half. In a recent conversation with a prominent contractor operating in the East, he said: "I have about two hundred horses in daily use, but I feel from my experience that the motor truck will soon replace the horse method of transportation."

During the last few years I have personally studied and made several investigations for the purpose of ascertaining the influence of road conditions upon the marketing of the motor truck.

In one state I made a canvass by mail, addressing all probable purchasers, and received over one hundred requests for data concerning the construction and operation of the motor truck.

Upon further investigation I found that there was not a single case where the business of the inquirer did not justify the purchase of at least one truck, but not more than five of the total number could be assured of dependable service from any truck, on account of the miserable and unreliable road conditions. Consequently they could not afford to purchase the truck for dry weather and be compelled to maintain their mules for wet weather.

Early last year we began to gather the names and addresses of those state and county officials thruout the entire United States whose duties brought them in contact with road construction, including the county judges, county commissioners, engineers and road supervisors. While gathering this list we prepared a small illustrated booklet with a view of telling the story of good roads value in the simplest manner.

After securing the complete list of officials, some 20,000, we mailed a letter to each official, inclosing copy of the booklet, and stated if they believed the mailing of the booklet to citizens of their communities would assist in the creation of good roads sentiment, we would be pleased to mail it, without charge, upon receipt of the names and addresses, for which we furnished blanks, also a stamped addressed envelope for their convenience in replying. In this manner our distribution of the booklet is running into hundreds of thousands and they are going into the homes of the farmers and others, among whom there are thousands who do not have the privilege of reading the periodicals devoted to road improvement.

In addition to the distribution as originally planned, and which I have described, we are receiving daily requests from good roads associations, chambers of commerce and county officials for quantities of the booklet to be used in good roads campaigns, and there are now in the United States more than twenty campaigns for bond issues for one-quarter to one million dollars, in which the booklet is being used as campaign literature.

We are going even farther where campaigns are under way: we are also furnishing cuts of the illustrations shown in the booklet, so that they may be reproduced in their county newspapers—and our work does not end there. We believe that one of the greatest steps for final and permanent road improvement is to educate the youth of to-day, who is the citizen of to-morrow, as to the true meaning of good roads.

To encourage the teaching of the subject we are co-operating by furnishing, without charge, copies of the booklet to all schools willing to take up the subject.

We have already had requests for supplies of the booklet from a large number of educational institutions, and as an example, we have furnished the state superintendent of the schools of Alabama 3,400 copies for distribution to the public school superintendents thruout the state, and since their distribution we have been receiving requests from the teachers themselves for their individual requirements.

The good roads associations and other organizations have invariably offered to pay for the booklet, but in no case have we accepted any money, regardless of quantity shipped.

We recently addressed a letter to every automobile dealer in the United States—about 20,000—enclosing a stamped addressed envelope for the return of a list of questions prepared for showing the road conditions in each territory, and their influence upon the promotion of both the motor truck and motor car business, as considered by the individual dealer in that territory.

To one who has not given the matter consideration, the replies would be almost astonishing, and more so when you realize the little interest shown on the part of the industry

toward the improvement of such conditions. Of a total of 3,542 replies received, 902 stated that the roads in their territory were from "Fair to Good;" 2,640 stated, "Fair to Bad," and "Fair" only during dry weather. Showing the influence of road conditions upon the economic use of the motor car and motor truck, 943 dealers replied they believed that from 25 to 50 per cent. of the year the use of the motor car and motor truck was practically prohibited in their territory; 611 from 50 to 75 per cent.; 259 from 75 to 100 per cent.; 1,177 dealers state that permanent roads in their territory would enable them to increase their sale of motor cars and motor trucks from 25 to 50 per cent.; 687 dealers from 50 to 75 per cent., and 276 from 75 to 100 per cent.

More enlightenment is needed as to the necessity of building permanent roads that will not only invite, but will withstand the abuse from heavy traffic unknown a few years ago, and it is also important that the public should be educated as to the value and necessity of proper road maintenance.

The Proper Use of Concrete Gravity Chutes

By W. H. Insley, Indianapolis, Ind.

The concrete gravity plant has had a very rapid development because of its undoubted economy in the time and labor cost of distributing concrete and its practically universal adaptability to all classes of concrete structures. The straight lift in a tower for the vertical distance between the mouth of the mixer and the top of the forms and then an additional lift of about one foot for every three of horizontal distance between the two before turning the concrete over to gravity to carry it across from the tower to the forms is about as near to nature's absolute foot-pound requirement as can well be devised.

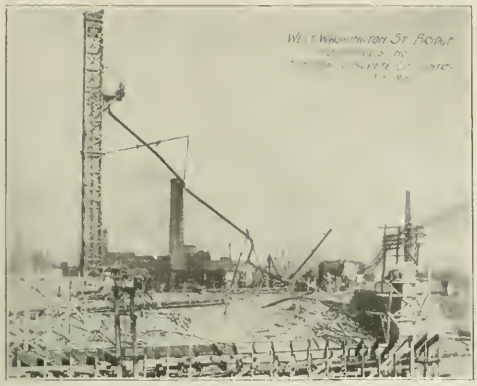
Like any new process which, because of easily apparent advantages, comes rapidly into general use, its use has out-run the rules of practice which more conservative introduction would have established for it, with the result that every user has made his own rules with little guidance except his own experience and with as variable a product as this procedure might suggest. It is well, therefore, that some thought be given to the statement of some of the fundamental conditions which must obtain to insure a good concrete, which is of absolute importance, as well as to realize the largest ultimate factor of economy in operation, these two ends being obtained by the same means, the one depending on the other, the best concrete being the most economical to handle.

The typical plant consists of a tower with a hoist bucket which takes the batch of concrete from the mixer, a receiving hopper with a controllable gate near the top of the tower into which the batch is dumped from the hoist bucket and a series of chutes or troughs which carry the concrete to the forms. The tower is frequently as high as two hundred feet and the line of chutes may carry the concrete as far as five hundred feet from the tower and by using a relay tower the concrete is placed in the forms at a thousand feet from the mixer. The chutes may be connected in a straight continuous line from the hopper to the forms or this line may be interrupted by line-gates thru which the concrete is dropped a vertical distance thru a closed pipe and then to the forms or by an assembly of horizontal swivel connected chutes it may travel in a more or less zig-zag path, dropping from the end of one chute into the swivel head of the chute below as it proceeds.

The matter of first importance to the successful operation of the gravity plant as well as of any method of distribution is the condition of the concrete when it is discharged from the mixer. Concrete is in proper condition for the gravity plant when it has been subjected to the action of a well designed mixer long enough to thoroughly incorporate all of the aggregates, the batch being assembled with the proper amount of water to hold all of the aggregates in suspension, the resultant mixture being a viscous, homogeneous mass. As to how long the batch should stay in the mixer and as to the amount of water in percentages which this requires, our interest, so far as the chutes are concerned, must be confined to resultants and we must consider these questions as proper subjects for separate discussion. The concrete should not be so dry that it will not level off on top as it stands in the bucket, nor should it be wet enough to show water on top of the bucket if left standing for an appreciable length of time nor to allow a stone to sink much over its own thickness when placed on top of the mass. Too dry concrete limits unnecessarily the range of distribution from a tower of a given height by requiring a steeper chute to carry it.

A wet concrete which allows the heavier aggregates to settle to the bottom will separate in travel and is to be avoided as one of the unpardonable sins. By all means let the concrete be too dry rather than too wet, but there is the right consistency which avoids both extremes. But these problems are problems of mixing, however vitally they may affect the economy of the distributing plant. Properly assembled and well mixed concrete will maintain its integrity by whatever method it may be distributed and concrete which is too wet will allow the stone to settle to the bottom of the form and the mortar will come to the top regardless of the means used to carry it there, while concrete properly assembled, but too hastily mixed will be very much improved by the movement thru a line of chutes as against any other method of transportation. It must be borne in mind, however, that the gravity plant is a plant of distribution and not for mixing and that the concrete must be good concrete, well mixed when it is delivered to the hoist bucket or it can not be expected to be good concrete when the forms are removed.

If the concrete reaches the chutes as a homogeneous mass the slope of the chutes is not of vital importance. That slope is generally the best which will allow the concrete to flow with the least velocity which will insure its passage altho a vertical drop in a closed pipe is a feature of many installations on important work. Such vertical lines, however, should have baffles every few feet to arrest the drop and the concrete should be distributed at the bottom by means of a horizontal chute whenever possible and not directly from the vertical line into the forms. The required minimum slope to carry the concrete properly will vary with the character of the aggregates, the average slope for small round gravel being 1 of rise to 3 of run or an angle of about 18 degrees with the horizontal, the slope for 1-inch stone about 1 to 2¾ or 20 degrees, for 1½-inch stone 1 to 2½-inch or 22 degrees, and for 2-inch stone 1 to 2¼ or 24 degrees with the horizontal. It is better practice on a long line to hang the chutes with a gradually and very slightly increasing grade as they travel toward

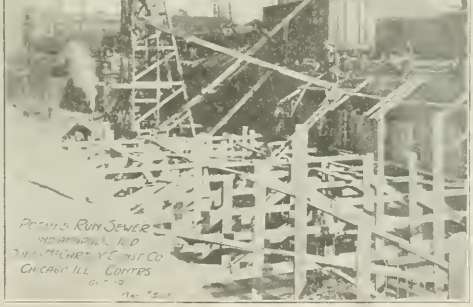


the lower end, such a grading being less likely to cause an overflow in the chutes than the reverse. The final distributing section which places the concrete in the forms should retard the concrete to as slow a movement as will carry it at all.

In the travel thru the chutes the concrete should flow in a constant, uniform stream so far as possible. The man on the tower at the hopper gate is a very important member of the operating crew. An intermittent rush of concrete is apt to congest the chutes causing overflows, shut downs, the retaining of concrete in the tower hopper for an undesirable length of time and damaged work.

The concrete should be placed by the chute as closely as possible at the point where it is to remain. For floors and shallow beams the final chute section should be easily portable with the mouth close to the forms and the concrete traveling as slowly as it can be made to run. For column forms and deep girders the gravity plant provides a closed, flexible drop pipe with frequent baffles or arresters for placing the concrete in the bottom of the form, obviating the objectionable practice of dropping it in the open from the top. If concrete is dropped from the top of a column form in the open or even in a closed pipe without obstruction, the kinetic energy of the stones in the aggregate will drive them toward the bottom of the mass, separating them from the mortar, while if frequent baffles are placed in the vertical pipe the mass will retain its homogeneous character.

To recapitulate, the greatest economy in operation is realized under the conditions which also disclose the best results in the character of the concrete when the forms are removed. The mixing crew must deliver to the bucket properly assembled and thoroly mixed concrete of a viscous, homogeneous consistency. The chutes should be hung at as flat a grade as will readily carry the concrete, this grade varying with variations in the size and character of the aggregates. The concrete should flow thru the chutes in a uniform, constant stream and should be placed by the chutes as close as possible to its final position, avoiding vertical drops without arresting baffles to neutralize the differences in kinetic energy of the aggregates within the mass. These conditions are primary, are easily realized on any work and will insure its success.



Laying Concrete Highway with Bituminous Wearing Surface—Details of Operation and Cost

A six-mile stretch of concrete pavement 15 feet wide and 4½ inches in depth has recently been completed by the California Highway Commission in Santa Barbara county between Santa Maria and Orcutt.

Concrete base was laid on a sandy subsoil, portions of which were very difficult to properly prepare. Numerous methods were adopted such as flooding the sand with water, using different weights of rollers, etc. As soon as the subgrade had been properly rolled, it was necessary to plank the same in order to keep the grade from cutting up.

The total amount of grading in the six-mile stretch was light, involving approximately the removal of 36,000 yards of material. The concrete base consisted of 1:2½:5 mixture placed and tamped in the usual way, with the exception that the surface of the concrete was left in a slightly roughened condition with small corrugations instead of the usual semi-smooth finish.

An asphaltic wearing surface 1½ inches in total thickness after compression was placed upon the finished concrete base, 51,100 square yards comprising the area covered.

Preparatory to laying this surfacing the concrete was thoroly cleaned of all dirt and dust films, 1½ by 2-inch header boards were added to existing 2 by 4 concrete base headers and the surface was treated to a paint binder coat.

The paint binder was composed of one part by volume of 80 to 90 penetration asphalt dissolved in 1½ parts of 50 degree Baumé distillate. The asphalt was heated along the road in a portable kettle and measured quantities in buckets were mixed with distillate at a safe distance from the fire. The paint mixture was then poured on the concrete and swept in an even film over the surface, care being used to obtain an even distribution so that no excess remained in depressions. The sweeping was performed with common house brooms.

As an illustration of the positive binding quality of the paint coat, sections cut out from the finished pavement were so thoroly bound that in tearing apart the two surfaces, portions of the broken concrete adhered to the Topeka surface.

The cost of cleaning concrete base and applying paint coat was as follows:

MATERIALS.

8 tons asphalt @ $8.75 per ton	$ 70.00
3745 gals. distillate @ 5c per gallon	187.25
2 cords wood @ $6.00 per cord	12.00
Tools, etc., plant	6.50
Total	$ 275.75

LABOR.

Total labor including 2-horse broom	$650.55
Pro rated superintendent, timekeeper, etc.	52.50
Bonds and insurance	54.90
4 per cent contractor's overhead	28.12
Total	$ 786.07
Total of both items	$1061.82

Unit cost—$0.0207 per square yard.

The Topeka asphaltic wearing surface is too well known to require any discussion here. However, it may be of interest to compare the actual results obtained in the field when checked against laboratory tests made at the state laboratory at Sacramento as shown in the accompanying table.

The hot mixture was turned out by a large portable Cummer plant having a capacity of approximately 300 to 1,000-pound batches per 8-hour day. Views of the plant are shown herewith.

The main plant is mounted on one set of railroad trucks 66 feet over all. An auxiliary flat car accompanied the main plant, loaded with accessories. In the order named the machinery was mounted on the main truck as follows: Boiler, open elevator, revolving drum (dryer), hot sand elevator, hopper, mixing box, weighing kettle, tank and agitator. This order is from right to left in the front view and from left to right in the rear view of the plant.

A 60-horse power engine and 80-horse power boiler mounted on skids and installed on the ground near by at the open elevator end of the trucks operated the different units.

On the opposite side of the mixing box the operator weighs out the proper amount of hot asphalt cement by means of a kettle suspended on a traveling beam scale. This hot asphaltic cement is placed in the mixing box in the regular way after the hot aggregate and cold marble dust have been thoroly mixed. About 1½ minutes were required for a thoro and proper mixture of all the ingredients. This mixing was done by two sets of blades revolving in opposite directions, the blades being staggered and the shafts so set that the blades on one shaft just cleared those on the opposite shaft.

The asphaltic cement was agitated in a two-compartment tank of about twenty barrels capacity each. Pressure is maintained by means of a small compressor installed in one end of tank to force the liquid asphalt thru a pipe and valve near the mixing box.

The mixing box was equipped with a horizontal sliding gate operated by steam valves controlled by a lever on the operator's platform. The finished batch was discharged thru this gate to the truck or wagon waiting below.

In preparing surface "hot stuff" at the mixing plant, the

TABLE OF CERTAIN ANALYSES OF "TOPEKA" MIX ASPHALTIC SURFACING SHOWING SACRAMENTO LABORATORY TEST AND FIELD TEST OF THE SAME DAY.

Date, 1915.		Apr. 26.		May 3.		May 6.		May 7.		May 15.		May 19.		May 20.	
Passing	Spec. betw.	A	B	A	L	A	B	A	B	A	B	A	B	A	B
200-mesh.....	8% and 13%	9.1	9.0	13.2	13.4	10.4	11.8	10.2	13.7	9.4	10.8	8.4	8.4	9.9	10.1
80—200.....	11% and 25%	19.6	19.0	23.8	19.7	20.1	19.0	21.5	20.0	16.9	19.5	23.0	21.8	18.0	21.9
10—80.....	17% and 29%	24.1	21.0	27.4	27.0	26.6	25.0	28.3	27.0	27.3	26.7	25.8	26.5	27.4	24.2
10—40.....	5% and 11%	11.5	10.5	10.1	10.3	10.8	11.8	11.2	11.5	13.3	11.8	10.8	11.3	12.3	11.7
1—10.....	15% and 25%	18.0	22.0	6.3	4.0	15.3	16.0	12.0	11.9	14.9	14.4	17.0	16.2	18.5	16.2
2—4.....	3% and 10%	9.2	9.0	5.3	6.0	7.0	6.7	6.8	6.4	8.8	7.2	6.4	6.2	4.2	6.3
Bitumen.....7½% and 10%		8.5	*9.5	9.6	*9.6	9.8	*9.7	10.0	*9.5	9.4	*9.6	8.6	*9.6	9.7	*9.6

Note: A—Sacramento laboratory test; B—field test; * represents per cent. of bitumen calculated.

Under the revolving drum a battery of oil burners was arranged, the flames being so regulated as to keep the temperature of the dry mix at approximately 325 degrees Fahrenheit.

In order to check the temperature of the dry mix, test samples were taken from a trap door in the bottom of the hot elevator near the discharge end of the dryer.

The hot aggregates were elevated about 30 feet thru a closed chute and dumped into a closed hopper of about one cubic yard capacity. This hopper had a bottom discharge consisting of a sliding gate controlled by a lever on the mixing platform. The gate opens into a box nine cubic feet in capacity, which in turn empties thru a similar gate controlled in the same manner, into the mixing box.

The carbonate of lime or dust filler was measured separately on a small wooden platform adjacent to the mixing box and placed by hand. This method is not very satisfactory.

asphaltic cement and stone dust were weighed separately into each batch, the sand and broken stone screenings were brought in piles to wagons and the proper proportions of each carried to position adjacent to bucket elevator by a fresno scraper and spread in layers. By cutting across the layers with their shovels, two laborers feeding the bucket elevator were so controlled that the mixing ensuing came well within the desired specifications. The plant inspector checked the mixture by taking samples from time to time during the day from the mixer box—such samples containing everything excepting the asphaltic cement and being thoroly mixed. A 2-pound sample was run thru the sieves, and, owing to the size of sample, operative errors were reduced to a minimum. As an interesting corollary, these tests checked with Sacramento laboratory analyses of finished pavement to a degree of exactness rarely encountered.

FRONT VIEW OF CUMMER MIXING PLANT.

The materials entering into the mixture were obtained as follows:

1 Sand—Santa Maria river.
  (a) A fine blow (surface) sand.
  (b) A medium fine sand (12 to 18 in. below surface).
2 Broken stone screenings—Daugherty quarry—S. L. O.
  (a) Passing ½ in., retained on ¼ in.
  (b) Passing ¼ in., retained on 10-mesh.
3 Pulverized limestone—Western Rock Products Company, San Francisco, Cal.
4 Asphaltic cement—California Liquid Asphalt Company, Hadley, Cal.

The materials hauled to the plant cost as follows:

Sand, per ton	$0.75
Screenings, per ton	1.60
Limestone (dust), per ton	6.10
Asphaltic cement, per ton	8.75

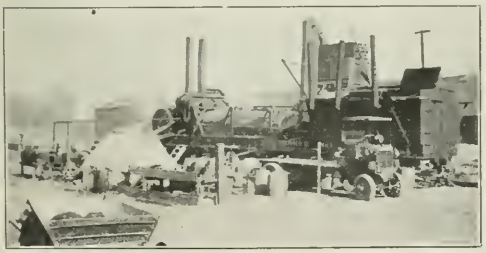
The mixing process at the plant was carried thru so that the complete cycle of each batch averaged 1¾ minutes, which limited the capacity of the plant to 280 batches, weighing approximately 1,000 pounds each, or 140 tons of "hot stuff" per 8-hour day. A complete cost of plant operation, batch and ton costs of mixture, etc., is appended to this report.

Some little difficulty was experienced in deciding upon the proper amount of asphaltic cement to add to the mixture during the first period of the work. In order to obtain proper "pat stains" and to keep a firm pavement under the rolling, the amount of asphaltic cement per 1,000-pound batch was increased from 92 pounds to 98 pounds, and subsequently decreased to 96, at which point the greater portion of mixture was turned out. Based on "pat stains," 97 to 98 pounds of asphaltic cement per 1,000-pound batch seemed to be the proper amount, but excessive "balling up" occurred in the raking and the surfacing "jellied" under the roller, so this amount was cut back to 96 pounds.

The plant operation was carried on with the following labor:

General superintendent	½	day	@ $7.50	$3.75
Foreman	1	day	@ 5.00	5.00
Engineer	1	day	@ 5.00	5.00
Watchman	1	day	@ 3.00	3.00
Mixerman	1	day	@ 3.00	3.00
Asphalt man	1	day	@ 2.75	2.75
Laborer	1	day	@ 2.75	2.75
Laborer	2	dys.	@ 2.50	5.00
2-h. Fresno, team and driver	1	day	@ 5.00	5.00
Total				$35.25

The mixture was hauled to place on the pavement in three 5-ton motor trucks with end dump bodies, each truck load consisting of 13 batches or approximately 6½ tons. The contractor paid for this hauling at the rate of 30c per batch. The average haul was three miles. The haul therefore cost 20c per ton mile. The hauling contractor paid his drivers full time on this work, and kept four trucks on hand (one for emergency), and, owing to the delays due to wet weather (12 days out of 36), his profit was a very meager one.



REAR VIEW OF CUMMER MIXING PLANT.

A typical paving gang on this work consisted of thirteen men, as follows:

General superintendent	½	day	@ $7.50	$3.75
Foreman	1	day	@ 6.00	6.00
Rollerman	1	day	@ 5.00	5.00
Raker	1	day	@ 3.50	3.50
Raker	2	days	@ 3.00	6.00
Tamper	1	day	@ 2.75	2.75
Shovelers	5	days	@ 2.50	12.50
Hand rollerman	2	days	@ 2.50	5.00
Total				$44.50

An average day's work for this gang is 2,000 sq. yds. of 1½-inch surfacing. The above amount of $44.50 does not represent the total cost of laying, as certain lost time charges, general superintendence and contractor's overhead and some incidental supplies and plant charges must be added. Complete laying costs appear in cost data supplementary hereto.

Cost Data.

PLANT OPERATION.

Setting up plant	$241.70
Wrecking plant	68.25
Labor at plant (mixing)	914.00
Labor at plant (watchman)	119.75
Blacksmith work	14.50
Superintendent, timekeeper, horse and buggy (one-half total cost)	210.00
Water	40.00
Oils and fire brick, etc.	29.82
Hardware, etc., belting	50.00
Wood for fuel	100.00
Gas for fuel	290.50
Rental at $50 per day	1,500.00
Freight on plant (and return)	870.00
Incidentals—R. R. fare, etc.	35.00
Bonds and liability insurance	249.60
Phone, etc.	37.50
Freight on wagons and tools and depreciation on same	300.00
	$5,040.62
Plus 4 per cent	102.73
	$5,143.35

LAYING SURFACING.

Labor	$1,247.15
Rolling	205.00
Transporting men, etc.	250.00
Headers (labor)	103.70
Superintendent, timekeeper, etc.	157.50
Insurance and bonds	164.70
Railroad fare (incidentals)	35.00
Phone, etc.	37.50
Freight on equipment and tools, and interest and depreciation on same	200.00
Supplies for roller	13.00
5.86 tons coal for roller	88.00
Hardware, etc.	43.50
Lumber for headers	504.70
	$3,049.75
Plus 4 per cent	78.53
	$3,128.28

PAINT COAT.

Total	$1,061.82
Incidental work—shoulders, etc.	$522.15

MATERIALS.

Hauling sand and other materials	$1,656.50
Unloading stone dust	28.45
Screening rock (dirty)	89.65
1,083.13 tons rock (screenings)	1,158.97
286 tons extra sand	128.70
344.05 tons asphaltic cement at $8.75	3,010.45
210 tons limestone dust at $6.10	1,281.00
	$7,353.72

Hauling "hot stuff" by contract:

30c per batch, 7,580 batches $2,274.00

(40 batches rejected on job; 7,540 batches net in pavement.)

SUMMARY.

	Total.	Per Sq. Yd.	Per Ton.	Materials and Mixing Per Ton.
Clean concrete and paint coat	$1,061.82	$0.0207	$0.282	
Laying surfacing	3,128.28	0.0612	0.830	
Plant operation	5,143.35	0.1005	1.364	$1.364
Incidental work on shoulders	522.15	0.0102	0.138	
Materials for mixture	7,353.72	0.1440	1.951	1.951
*Hauling mixture	2,274.00	0.0445	0.604	
Totals	$19,483.32	$0.3811	$5.169	$3.315

*Note.—40 batches, or 20 tons, of mixture were thrown out on the work, leaving 7,540 batches to go into the pavement.

From May 9 to 27, 1915, inclusive, motor trucks hauling hot mixture traveled over the 2½ miles of completed pavement. Each truck, full, weighed approximately 24,000 pounds; empty, 11,000 pounds. The average daily tonnage due to this traffic alone was 282 tons, and the concentration of load (12 tons on loaded trucks) was extreme. During this period the minimum temperature (atmospheric) was 48 deg. F. and the maximum 97 deg. F. A careful examination of the finished surfacing disclosed no signs whatsoever of faulty spots, rolls or line cracks on May 28.

With the opening of the complete road the expected heavy traffic has resumed travel on this route and later in the year some tonnage records of interest will be available.

The above data were furnished thru the courtesy of Austin B. Fletcher, State Highway Engineer of California, and were taken from the report of Walter C. Howe, Division Engineer.

New Chicago Bridge Design

The city of Chicago has accepted the design for new bridges proposed by the Illinois chapter of the American Institute of Architects

At a meeting in the office of William Morehouse, commissioner of public works, it was decided to use the design for the bridges at Madison, Franklin, Clark and La Salle streets, work on which will commence soon. Those who conferred with Mr. Morehouse were Thomas Pihlfeldt, engineer of bridges for the city, and the following members of the municipal art committee of the American Institute of Architects: George W. Maher, chairman; E. C. Jensen, Hubert Burnham, Earl H. Reed, Jr., L. E. Stanhope, H. F. Stevens, and Mr. J. Schiavoni.

At the approaches to the bridges will be bronze groups of statuary. About twenty-five feet nearer the bridge will be heroic pylons, severely plain, but ornamented on the top with the Chicago seal. Granite balustrades will connect the pedestals on which the statuary is to stand with the pylons.

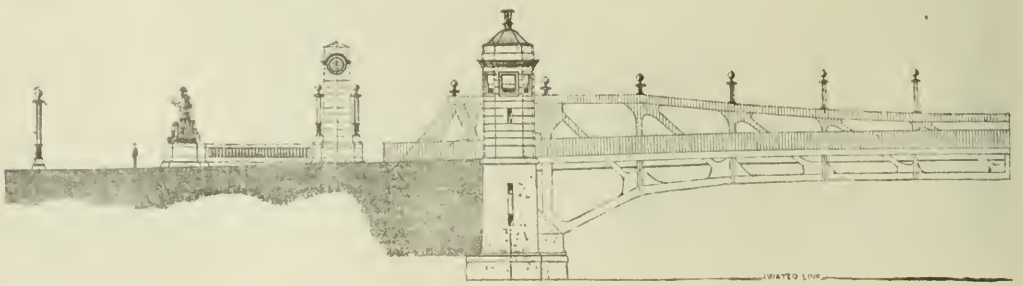
The tower houses are to be built of terra cotta of a granite texture. In the past these have been built of wood, galvanized iron, and concrete. The pylons will be 26 feet high.

Good Roads Notes

Kansas will organize its prisoners for road work and will shorten each sentence one day for every three that the man works faithfully and cheerfully on the public roads. Municipalities can have the labor by paying $1 for each day's labor for each man employed. About half of this sum will be used in feeding and caring for the man and the remainder will be paid to him or to his family.

While the Shackleford good roads bill has passed the United States House of Representatives by a vote of 281 to 81 the prospects of the bill do not seem so promising in the Senate. Several senators have bills of their own which differ more or less from the one which has run the gauntlet of the House and have strength which must be reckoned with. Too many of the bills have the odor of the pork barrel which has been a piece of congressional furniture for so long and no law will be preferable to laws of the nature of some of them. The preparedness program should by all means include highway improvement, for good roads are an absolute essential to prompt and rapid movements and good roads can not be built in a day, while automobiles and horses can always be obtained on the shortest possible notice.

The Shackleford bill, which has passed the House, would appropriate $25,000,000 to aid the states in improving post roads of importance, outside of cities or towns of 2,000 population or more. Each state would receive $65,000 plus its share of half the remainder in proportion to population and of the other half in proportion to mileage of rural free delivery routes in operation, from 30 to 50 per cent. of the total reasonable cost of the construction of maintenance of an approved road being paid from the funds. The shares of the states are computed to range from $101,102 in Nevada to $1,594,412 in New York. Illinois, Ohio, Pennsylvania and Texas are the only other states which would receive more than $1,000,000 each.

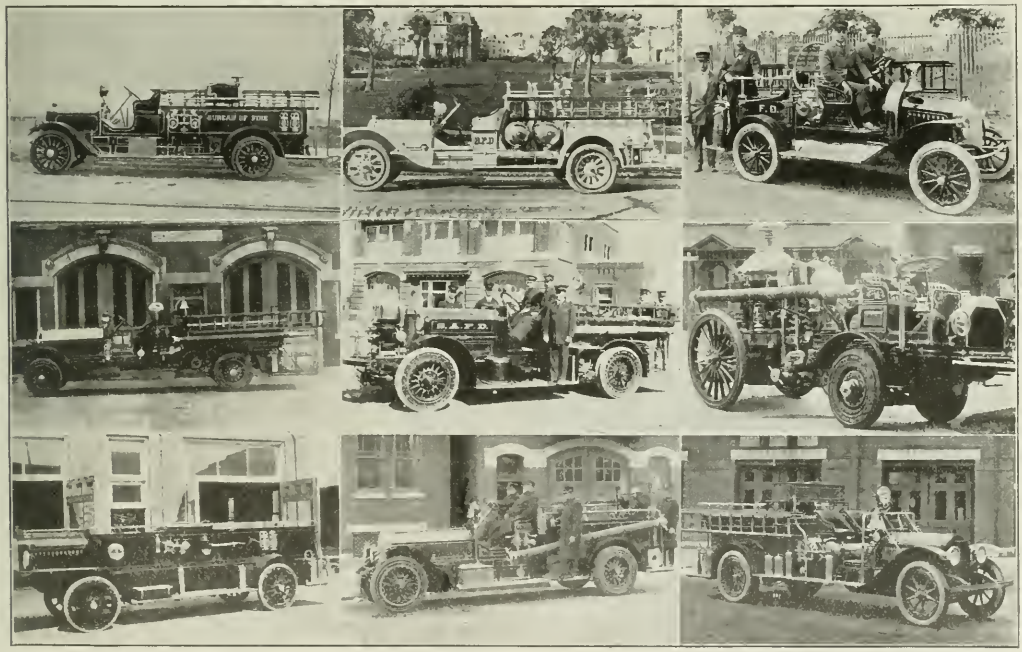


FIRE DEPARTMENT

New Developments in Fire Apparatus

A recent demonstration of electrically driven fire apparatus was held on the steep grades in and around Paterson, N. J., during November at the time of its initial installation in that city. The tests showed the remarkable power of a combination chemical engine and hose wagon fully equipped with twenty lengths of hose and a crew of fourteen men, weighing in all 18,320 pounds, and a second piece of apparatus, consisting of a 65-foot aerial ladder, carrying a crew of twenty-two men, with total weight of 20,000 pounds.

These two pieces negotiated an 18.23 per cent. grade, over an uneven cobblestone paving, in 1 minute 13 seconds, starting at the foot of the hill from a dead stop. This hill always had been used as a test hill for every piece of apparatus used by the Paterson fire department, and the previous fastest time had been 1 minute 40 seconds. It is interesting that these pieces of electrically driven apparatus made the run from Philadelphia to Paterson, approximating 125 miles, in fourteen hours, elapsed time, including stops at Trenton, New Brunswick and Newark.



BOYD COMBINATION CHEMICAL AND HOSE, PHILADELPHIA, PA.

SOUTH BEND TRIPLE COMBINATION, INDEPENDENCE, KANS.

DUPLEX COMBINATION FOUR WHEEL DRIVE, CHARLOTTE, MICH.

WHITE COMBINATION CHEMICAL AND HOSE, BAKERSFIELD, CAL.

AHRENS-FOX PUMPER EQUIPPED WITH SEWELL CUSHION WHEELS, SAN ANTONIO, TEX.

BOYD COMBINATION CHEMICAL AND HOSE, CAMDEN, N. J.

CENTRAL WAGON COMBINATION SEAGRAVE TWO-WHEEL TRACTOR FOR STEAM ENGINE.

SEWELL CUSHION WHEELS, INDIANAPOLIS, IND.

WHITE COMBINATION CHEMICAL AND HOSE, BEVERLY, MASS.

FIRE APPARATUS STATISTICS.

In 315 cities with population of over 10,000 each, there were, in 1913, 7,059 pieces of horse-drawn fire-fighting equipment. In 500 cities of the same class there were, in 1914, 5,897 pieces of horse apparatus, or with 60 per cent. increase of listed cities a decrease of 1,162 pieces of horse apparatus. In these 500 cities motor apparatus included 211 pumping engines, 118 triple combination pump, chemical and hose cars, 700 combination chemical and hose wagons, 201 ladder trucks, 269 pieces of apparatus drawn by tractors, and 724 cars of all classes; a total of about 2,300 pieces of motor fire apparatus. In 1916 appropriations for the purchase of $15,000,000 worth of motor fire apparatus have already been made by American cities, and yet only 50 per cent. of the cities in the United States maintaining fire departments have a single piece of motor-drawn apparatus.

HAVE THIRTY MOTOR PIECES.

The city of Boston, Mass., has thirty pieces of motor apparatus in its fire department. All of the chiefs are supplied and a long stride has been taken in motorization, according to the plans laid down several years ago, and which have been indorsed by the present administration. The mayor believes that motorization is one of the most important lines of progress that the city should pursue, but owing to lack of funds he has been obliged to curtail plans for the year. All the tractors that have been delivered to the department within the past year, the gas pumping engine and several chemical wagons have given the greatest satisfaction. Certain sections of the city that have never been adequately protected are now held to be much safer with the installation of motor apparatus, especially in the districts of heavy grade, such as Orient Heights and the Parker Hill section of Roxbury.

DUPLEX FOUR WHEEL DRIVE.

In this issue we illustrate an approved type of duplex apparatus possessing traction upon all four wheels. Together with its broad range of eight speeds, it is possible to get an extremely low reduction as well as extremely high gear. With the eight-speed feature, the truck has a range of speed from 1 mile per hour to 50 miles per hour with the motor running at its maximum efficiency. This allows it to make the side streets thru mud, sand, snow and up the heavy grades.

The following statement shows the upkeep and running expense of the Charlotte (Mich.) duplex motor fire truck from September 20 to November 22:

Sept. 20—First test, traveled 11 miles, consumed 7½ gallons of gasoline	$0.75
Sept. 23—Demonstration for drivers, 3.6 miles, consumed 1.5 gallons of gasoline	.15
Sept. 30—Two trips to fair grounds for exhibition purposes, gasoline consumed, 5 gallons	.50
Oct. 4—Demonstration for drivers, 4 gallons of gasoline consumed	.40
Oct. 19—Exhibition (Wolverine Paved-way) 7 gallons of gasoline consumed	.70
Oct. 22—Fire call, Hildreth's barn, 4 gallons of gasoline	.40
Oct. 28—Exhibition before Grand Rapids business men, 2 gallons gasoline consumed	.20
Nov. 4—Fire drill, 3 gallons of gasoline consumed	.36
Nov. 6—Fire call, on West Lawrence avenue, 3 gallons	.36
Nov. 7—Fan belt	.40
Nov. 10—Fire drill, gasoline consumed, 2.5 gallons	.30
Nov. 12—Fire call, Solomon's barn (gasoline not measured).	
Nov. 18—Fire call, gasoline consumed, 3 gallons	.45
Nov. 22—Fire call, gasoline consumed, 7 gallons	.95
Total cost	$6.02

The foregoing statement covers a period of 66 days, or until the week ending November 27, which shows a cost of 9.8 cents per day up-keep.

The truck is equipped with Westinghouse starting and lighting system, with two electric headlights, one red tail light and an extra powerful searchlight mounted on the dash and swinging on a swivel so that it can be turned in any direction and the Bosch dual ignition system. The transmission is the selective sliding gear type, with eight speeds forward and two reverse, ranging from a ratio of 5½ to 1 on high to 64 to 1 on low.

The fire-fighting equipment consists of one 40-gallon chemical tank, nickel plated, with the latest improved agitator for mixing the chemicals and a steel basket containing 150 feet of best rubber chemical hose; one 30-foot trussed extension ladder, one 15-foot trussed hook ladder, two pike poles, one heavy door-opener, one crow bar, two axes, two lanterns, two hand chemical tanks, large gong, extra charge of chemicals for the big tank and stakes for hose pipes. The steel hose box has a capacity for 1,500 feet of standard fire hose. Underneath the rear and opening onto the back step is a large box for helmets and other accessories. The upholstering is of a genuine handbuffed leather. A draw bar thru the frame in the rear permits a trailer to be attached in emergencies. The tires are Goodyear cellular cushion, solid rubber, made especially for motor fire trucks. The approximate weight without the hose load is 6,800 pounds.

ALAMEDA'S COMBINATION FIRE TRUCK.

Alameda, Cal., has adapted a Packard 2-ton chainless chassis to fire department service. The special body carries combination water and chemical apparatus, including two chemical tanks and ¾-inch hose, several reels of 3-inch water hose, extinguishers, extension ladders, axes, door-openers, etc. A speed of 30 miles per hour is easily attainable by leaving off the standard motor governor.

Growth of the Automobile Industry

Some results of the U. S. census of the automobile industry for 1914 are available, together with comparisons with the census of 1909. In the five years there was an increase of 350.3 per cent. in the number of automobiles made and of 181.7 per cent. in the total value. The decrease in unit cost which these figures indicate was due in part to a general reduction in prices, but mainly to the greater increase in number of the low-priced cars, which itself would considerably reduce the average cost.

The total number of gasoline and steam automobiles made in 1914 was 568,399 and of electrics 4,715.

The increase in number of gasoline and steam machines over 1909 was 360.4 per cent. and in number of electrics was 22.9 per cent. The increase in number of delivery wagons was much greater than the average of all automobiles, the increase being from 2,771 in 1909 to 22,753 in 1914, or 721.1 per cent.

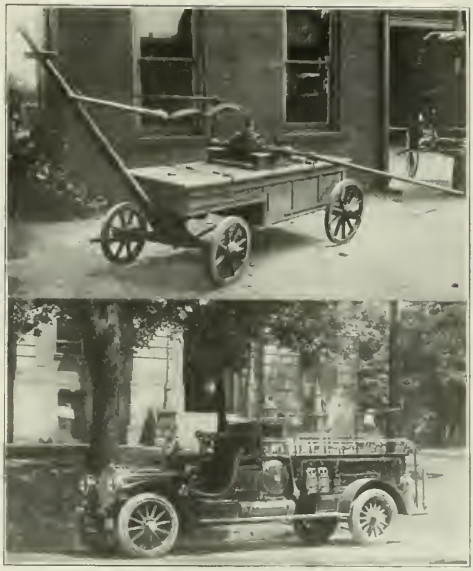
The popular car had from 20 to 29-h.p. in 1914, the number of such cars being 346,399. The 30 to 49-h.p. cars were next, with 163,468, and others were much less, down to 391, with less than 10-h.p.

Test of Steam and Electric Plant in New York Hall of Records

Quite a controversy has arisen over the issue of a report on a recent test of the steam and electric plant in the New Yory City Hall of Records. The Bureau of Municipal Research, an independent organization, the boro of Manhattan and the New York Edison Co., were represented in the test and the latter has made publication in advance of the issue of the official report, to the effect that the plant in the building can be operated more cheaply with current supplied by that company than by operating the building's own plant. The Bureau of Municipal Research states that its counsel advises it that the rate of electricity must be materially reduced before this statement can be true and that some changes in the local plant will materially improve its efficiency. Under present conditions and the present public service rate of 3 cents per kw.-hr. for electric current the loss per year to the city by using Edison Company's current would be $9,400, and a reduction to $1.66 cents per kw.-hr. in the charge for current would be required to offset this difference.

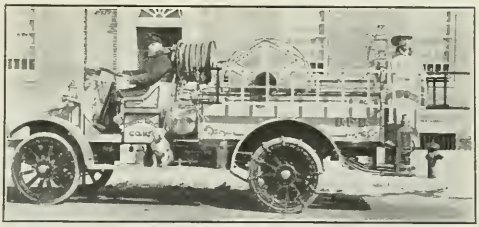
Fire Department Notes

William Guerin started in the New York fire department as a fireman in 1889, when Hugh Bonner was chief. He worked his way up the ladder, earning promotion through the successive grades of engineer, lieutenant, captain and deputy chief. He missed by a fraction of 1 per cent. appointment as head of the department, but he has done a greater work in establishing the City Fire Prevention Bureau. From 1911 to 1913, when he retired, the fire loss of New York City was reduced by many millions of dollars a year as a result of reforms instituted by Chief Guerin. It showed what could be done. At once the idea spread over the country. Portland, Ore., was one of the most successful cities in establishing bureaus of this kind. Factories were cleaned up, fire alarm systems overhauled, extinguishers installed and means of egress cleared or enlarged. A striking example of Chief Guerin's knowledge of fire hazards was shown early in December, when Hopewell, Va., was wiped off the map because it neglected to take the precautions that he advised. In August Chief Guerin was called into consultation by the Business Men's Association of Hopewell. He made an inspection of the "magic city" and then entered his report, urging that inasmuch as there was no water supply, the city be equipped with small one-quart fire extinguishers. "A daily miracle is performed when the sun rises and finds your city intact," he wrote, and he added: "What you have to fear most is fire, for if it once got any great headway, your city's name would be Hopeless." His warning was ignored and the city was swept away. He has been chosen as head of the new engineering bureau recently established by the Pyrene Manufacturing Company.

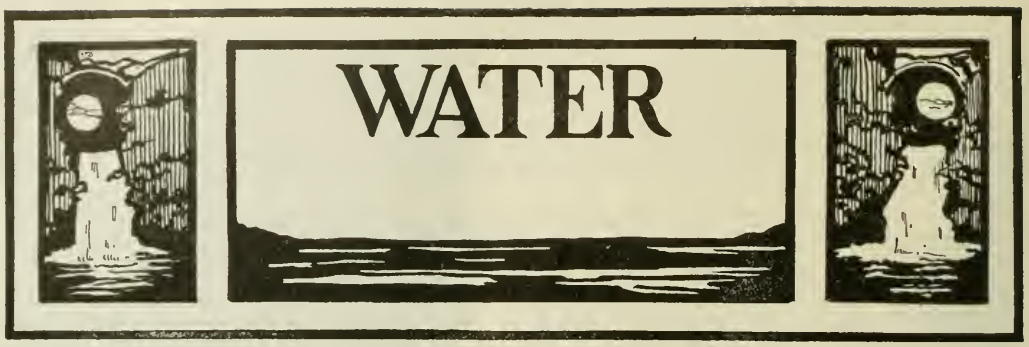


The volunteer fire department of Beaver, Pa., D. A. Moore, chief, has a Boyd chemical and hose motor truck, a horse-drawn ladder truck and a hand-drawn hose reel. Municipal water works pressure is 100 to 105 pounds. The two photographs accompanying show the latest piece of fire apparatus and what may have been the earliest in Beaver. At any rate, the old hand pump and cistern on the low wagon wheels is older than any one now living can remember.

The accompanying photograph was sent us by W. C. Jamison, chief of the fire department of Dover, Del., who is standing on the rear of the motor-driven chemical and hose combination shown. The chassis is a Kelly 4-cylinder machine equipped by the United States Fire Apparatus Co., of Wilmington, Del., from plans drawn by the Robbins Hose Co., No. 1, who operate the machine. The equipment consists of a 35-gal. chemical tank with 200 ft. of $3\frac{1}{4}$-in. hose; 1000 ft. of $2\frac{1}{2}$-in. hose on the reel in the center; a 10-ft. roof ladder; a 20-ft. extension lad-



der; an acid holder, two 3-gal. hand extinguishers, 2 nozzles, ax, bar, 2 lockers in rear of body for tools and equipment for eight men, four of whom use the covers of the lockers for seats. It is a 1-ton truck, but readily and often carries $1\frac{1}{2}$ tons. Chief Jamison enjoys looking over the machines shown by other chief engineers and reciprocates by sending a description of their product. The background shows a little of the detail of the architecture of the Delaware state capitol.



Pumping Station Profits By Substitution of Electric Power for Steam

By John A. Randolph
The Society for Electrical Development, Inc.

At the Springdale pumping station, which furnishes the entire water supply for the town of Canton, Mass., the power for a new equipment of electric pumps supplanting a former steam installation has cost less during the past year than the coal used for the formerly used steam pumps, and a large saving has been effected in labor.

The steam equipment had been in service for 24 years. It comprised two horizontal boilers and two large compound duplex steam pumps of 700 gallons per minute capacity, with condenser and boiler feed pumps.

The new electric equipment is made up of one 400-gallon-per-minute DeLaval 3-stage centrifugal pump direct-connected to a 25-h. p. motor, running at 1,750r. p. m., and one 700-gallon 2-stage pump direct-connected to a 75-h. p. motor. The latter pump is reserved for fire use only.

Since the installation of the electrical pumps, the income from metered water has been increased from $12,826 to $14,432. This is due to the higher water lever maintained in the standpipe by the long slow pumping day and night.

The electrical outfits have an advantage over the former steam equipment in that they are much smaller and more compact. The two electrics were installed in the space formerly occupied by one of the steam pumps. The centrifugal pumps are simpler in construction owing to the absence of a multiplicity of valves, pistons, reciprocating parts and packing boxes. They are thoroly reliable and are readily adaptable to automatic control. The station and premises can be kept much cleaner with electric power than with the use of steam.

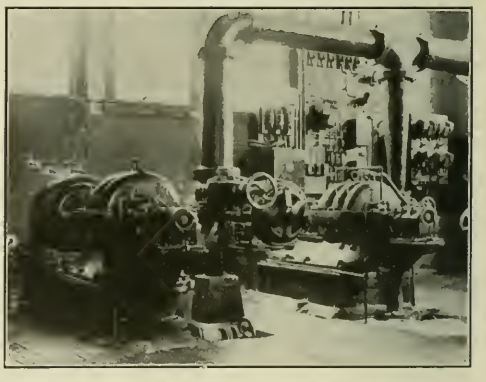
For starting and stopping the electrical pumps a Cutler-Hammer starter designed for remote control is used. This device has been connected to several pieces of control apparatus placed at various points for the purpose of automatically starting or stopping the pump as required. One connection is made to a float switch in the well, which actuates the relay of the starter when the well is empty thereby stopping the pump and preventing the uncovering of the check valve.

Another connection is made to a pressure gage, which starts the pump when the water level in the standpipe has dropped to a certain point.

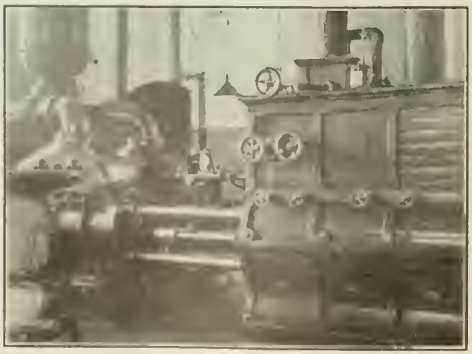
A time clock is also connected to the starter for the purpose of starting and stopping the pump three times each day on a regular schedule—morning, afternoon and midnight.

The total amount of water pumped last year was 106,000,000 gallons against an average working head of 190 feet or 82 pounds. The electrical energy required for this work was 120,000 kw.-hr. purchased at an average rate of 2 cents per kw.-hr. The coal used during the previous year with steam operation when 10 per cent. less water was pumped amounted to 442 tons, costing $6 per ton.

The electric power for this installation is furnished by the Edison Electric Illuminating Company of Boston.



ELECTRIC PUMPS *in space formerly occupied by one engine.*



ONE OF THE TWO *steam pumps used in the Canton, Mass., station previous to electrical installation.*

Efficiency Budget of Chicago

The first efficiency budget in the recent history of the city of Chicago has been transmitted to council. The result is an appropriation bill providing for reorganization of city departments that will effect an outright saving of $600,000 annually.

The total amount estimated as necessary to run the city departments for the year is $26,885,993, a figure nearly $2,000,000 below the estimate submitted by former Controller Traeger last year. It is a little in excess of the revised 1915 appropriation bill as passed by the city council.

It has been shown that if the proposed efficiency program is carried out the savings will amount to $610,882. This program calls for the following changes:

	Saving.
Consolidation and elimination of duplication in the inspection service as recommended by the efficiency division and approved by the controller	$405,582
Standardization of service and compensation in law dept. as recommended by the efficiency division	75,300
Consolidation of municip'l construct'n and repair shops	50,000
Consolidation of all municipal testing laboratories	20,000
Consolidation of all municipal storehouses and unification of delivery systems	10,000
Further estimated reduction in election expense	50,000
Total	$610,882

SUMMARY OF DEPARTMENT ESTIMATES AS GIVEN IN THE 1916 BUDGET:

Department No.		Controller's estimate. 1916.	Revised appropriation. 1915.	Expenditures year ended June 30, 1915.
9	Streets and alleys	$500.00	$450.00	$85.31
10	Harbors, wharves, bridges	500.00	500.00	502.29
11	Plan commission	.....	29,650.00	18,214.22
12	Committee on health	500.00	900.00	954.90
13	Railway terminals committee	.....	37,350.00	36,211.65
25	Board of election commissioners	1,345,045.00	724,607.00	829,701.97
26	Civil service commission	67,510.00	103,835.00	96,180.58
27	Department of supplies	34,666.38	32,545.12	29,923.61
30	Department of police	7,381,347.65	7,320,623.32	7,160,733.46
32	House of correction	360,226.02	374,767.02	364,349.36
34	Commission on gas litigation	100,000.00	.....	.....
35	Department of fire	3,544,880.40	3,544,385.92	3,523,043.28
36	Department of buildings	182,025.00	180,456.81	177,907.01
37	Department of health	1,313,097.20	1,507,444.09	1,523,436.60
40	Inspection of steam boilers, steam and cooling plants	48,498.52	53,125.12	50,436.90
41	Weights and measures	38,920.00	40,440.00	38,535.28
42	Smoke inspection	33,458.15	41,050.00	39,738.25
44	Hospitals	20,000.00	20,000.00	.....
45	Office of inspector of oils	15,960.00	16,420.00	15,980.37
46	Department of public welfare	43,385.00	49,360.00	44,749.17
50	Board of local improvements	786,366.37	995,997.56	906,248.22
52	City markets	1,990.00	1,990.00	.....
60	Special park commission	231,365.00	251,418.33	368,742.22
80	Department of electricity	2,922,863.02	2,522,135.27	2,475,571.45
90	Department of public service	94,313.95	119,662.56	129,960.48
101	Office commissioner public works	49,855.00	86,170.00	51,972.88
102	Bureau of compensation	7,645.00	8,010.00	7,313.63
103	Bureau of maps and plats	45,026.00	47,406.00	42,931.28
104	Bureau of architecture	73,784.08	84,659.08	29,012.56
105	Bureau of city hall	268,436.60	248,299.20	240,100.38
200	Bureau of streets	3,566,557.00	3,840,373.75	3,627,499.86
300	Bureau of sewers	519,423.00	485,915.80	499,175.06
400	Bureau bridges and viaducts	532,180.00	468,823.89	400,160.20
450	Bureau of rivers and harbors	323,375.45	309,025.75	272,452.27
	Totals	$27,496,885.26	$26,623,588.11	$26,195,573.79

Useful Knowledge for Well Drillers

By M. C. Potter.

In drilling wells it is not unusual for the bit to become jammed. Getting it loose is no easy task as every well driller knows.

Recently I was called in to assist in loosening a jammed bit in a well that was down to a depth of 170 feet. I had never tried anything of the sort before, so I had to proceed very cautiously to avoid damaging the bore hole.

I knew that dynamite wouldn't explode under certain water pressure; also that I must be very careful about waterproofing my charge, so I decided to try a half cartridge of 60 per cent. gelatin, made water-proof by inserting it in a small rubber sack. It was primed with a water-proof electric blasting cap and fired with a blasting machine.

I got the charge down close to the bit by weighting it so that it would sink and pull the leading wire down with it. It is necessary to have the wire free from kinks so that it will run smoothly.

This little shot released the bit without much damage to the bore hole.

I have since found that it is sometimes necessary to make three or four such shots to release a bit. The cost of the work will average about $5, which is money well spent because of the time it saves the well drillers.

MISCELLANEOUS

The March of Events

March 6-10, Sohmer Park, Montreal, Que. Canadian Good Roads Congress and Dominion Good Roads Association. Geo. A. McNamee, secretary, 909 New Birks Bldg., Montreal, P. Q.

March 8, New York City. Snow Removal Conference at 247 W. 54th St., by the divisions of highway and municipal engineers of the National Highway Association; the Automobile Club of America; the Citizens' Street Traffic Committee of Greater New York, and the graduate course in highway engineering of Columbia University, beginning at 8:30 p. m., with a lecture by W. H. Connell, on "Modern Methods of Snow Removal."

March 23, 24, St. Augustine, Fla. The Florida State Good Roads Association.

May 8-10, Waco, Tex. The Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Texas.

May 10-17, Indianapolis, Ind. The National Conference of Charities and Corrections.

June 4-8, New York City. The American Water Works Association. J. M. Diven, secretary, 47 State St., Troy, N. Y.

June 15-16, Cleveland, O. Ohio Society of Mechanical Steam and Electrical Engineers. J. L. Skeldon, president, Toledo, O.

June 28-30, Battle Creek, Mich. Michigan League of Municipalities.

July 9-16, Detroit, Mich. The World's Salesmanship Congress. Walter C. Cole, general secretary, Detroit Board of Commerce Building.

July 11, 12, Goshen, Ind. Municipal League of Indiana.

September 6-9, Newark, N. J. League of American Municipalities.

August 7-9, Houston, Tex. City Marshals' and Police Chiefs' Union of Texas.

Technical Associations

The American Road Builders' Association holds its elections prior to its congresses and on February 4 met in New York and elected as president E. A. Stevens, the New Jersey state commissioner of public roads.

The Water Power Development Association is a new organization made up of the manufacturers of hydraulic power and electrical apparatus and accessories to establish a propaganda for the reasonable development of water power in the United States, particularly on the public domain, and to advocate reasonable regulations for the operation of water powers on government lands and reservations. Marcus A. Beeman is the secretary, with offices in Washington. Representatives I. P. Morris Co., Allis-Chalmers Mfg. Co., Wellman-Seaver-Morgan Co., R. Thomas & Sons Co., and the Westinghouse Electric and Mfg. Co., are on the organization committee.

The National Municipal League offers two prizes of $30 and $20 to high school pupils for the two best essays on keeping highways clean, concerning which information will be given by Clinton Rogers Woodruff, secretary North American Building, Philadelphia Pa. The essays must be forwarded to him not later than April 15. The prizes for last year's essays on fire prevention were awarded to Margaret Reich, of Milwaukee, and Robert F. Matthews, of Louisville, there being 62 competitors.

The state bureau of municipal information of the New York State Conference of Mayors and Other City Officials, W. P. Capes, Albany, N. Y., director, has published data collected regarding methods and cost of collecting and disposing of garbage in about 50 cities in New York and about the same number of cities in other states and a digest of the data and the letters accompanying the information blanks, which will give some interesting information and shows some improvement in the treatment of this important city problem. There is room for very much more improvement.

The League of Iowa Municipalities has called a meeting at the Savery hotel, Des Moines, Iowa, for March 14, 10 a. m., to consider the effect of the defeat of Winchester, Ky., in its contest over the septic tank patent and to take such action as those present may deem advisable. F. G. Pierce, secretary, Marshalltown, Iowa.

The municipal engineers of the city of New York on February 23 heard a paper on the new roads around Ashokan reservoir by Francis B. March, assistant designing engineer; J. D. Groves, assistant engineer, and Charles E. Price, inspector. Daniel L. Turner, is president for 1916 and George A. Taber is secretary.

Technical Schools

The illustrated lectures on highway engineering at Columbia University, New York, in March include one on drainage and foundation problems due to soil and other geological conditions by Charles J. Bennett, Connecticut state highway commissioner on the 6th; one on modern methods of snow removal by William H. Connell, chief of the bureau of highways and street cleaning of Philadelphia, on the 8th; one on loadings and floors for highway bridges, by Walter R. Marden, chief engineer of the United Construction Co., on the 13th, and one on methods of securing an efficient engineering organization in states and municipalities, by John A. Bensel, consulting engineer, New York, on the 20th.

An important conference on drainage and related subjects will be held at the University of Illinois under the auspices of the Department of Civil Engineering, March 8-11, 1916. Land reclamation, flood protection, levee construction, and the importance of such work to the agricultural interests of the

state are subjects which will be discussed by engineers and contractors who have specialized in such work. The program includes the names of such men of prominence as George Parsons, president of the National Drainage Congress; Edmund T. Perkins, and Isham Randolph, consulting engineers; S. H. McCrory, chief of drainage investigations, United States Department of Agriculture, and W. L. Park, Illinois Central Railroad. The practicability will be considered of having an annual short course in drainage engineering under the direction of Professor F. H. Newell, head of the department of civil engineering and formerly director of the United States Reclamation Service. All who are interested in the subjects mentioned are cordially invited to attend.

Personal Notes

Ossian E. Carr is the new city manager of Niagara Falls, N. Y., having moved up from a like position in Cadillac, Mich.

F. H. Williams has been promoted to the office of city manager of Brownsville, Tex., having had charge heretofore of the water and light plant.

Chester E. Albright is the new chief engineer of the bureau of surveys of the Department of Public Works of Philadelphia, Pa., under the general change of officials made by the new mayor.

Arthur W. Kreinheder is the new commissioner of public works of Buffalo, N. Y., taking the place of Francis G. Ward, deceased.

D. W. Chamberlain is surveyor for the county highway commission of El Paso, Tex.

Edward B. Codwise is again appointed city engineer of Kingston, N. Y.

W. M. Donley is engineer of Allegheny county, Pa., which is doing a large amount of road construction.

E. E. Porter is city engineer of Uniontown, Pa.

J. M. Snow has been appointed city engineer of New City, Pa.

E. G. Bush is the county road superintendent for Clay county, at Brazil, Ind.

Brooks Connell has been appointed road engineer of Pike county, Alabama.

C. W. Folger is the new county road superintendent for Bartholomew county, at Columbus, Ind.

A. L. LaRoche is a new deputy city engineer in Binghamton, N. Y.

B. K. Finch is city engineer of Wilkes-Barre, Pa., under the city commission, which recently took office.

Following are newly-elected mayors:

W. F. Elliott, at Harrisburg, Ore.

Dr. J. P. Truax, at Grant's Pass, Ore.

Eugene Courtney, at Lafayette, Ore.

Capt. R. A. Bensell, at Newport, Ore.

Dr. H. A. Beauchamp, at Stayton, Ore.

Mrs. Clara Larsson, at Troutdale, Ore.

Andrew Kershaw, at Willamina, Ore.

J. V. Josek, at Wilkes-Barre, Pa.

A. N. Johnson, recently with the Bureau of Municipal Research, New York City, and formerly in charge in succession of the state highway departments of Maryland and of Illinois, is now the consulting highway engineer of the Association of American Portland Cement Manufacturers.

The following are newly-appointed chiefs of fire departments and fire commissioners:

R. L. Patterson, president of fire commission at Elizabeth, N. J.

William Berger, at Tremont, O.

Taylor C. Burke, at Chester, Pa.

Allie Longtine, at Titusville, Pa.

Frank Hochreiter, at Wilkes-Barre, Pa.

William H. Covell, commissioner at Providence, R. I.

The following are newly-appointed chiefs of police and heads of safety departments:

John Martin, at Buffalo, N. Y.

L. Kummer, city marshal at Troutdale, Ore.

W. J. Cullen, at Hazleton, Pa.

Theodore Chelow, commissioner at New City, Pa.

H. S. Edwards, at Titusville, Pa.

Fred Goeringer, superintendent of public safety, and E. S. Zoeller, chief of police, at Wilkes-Barre, Pa.

Joseph A. Black, at Charleston, S. C.

J. E. Orr, at Lancaster, S. C.

The following are newly-appointed street commissioners and heads of street departments:

S. S. Glasgow, at Oxford, O.

W. D. Gerlach, at Hazleton, Pa.

W. J. Welter, at New City, Pa.

John Williams, at Uniontown, Pa.

Martin Murray, at Wilkes-Barre, Pa.

H. M. Wells, at Salt Lake City, Utah.

H. K. Barrows will continue practice as a consulting hydraulic engineer in water power, water supply and sewerage, at 6 Beacon street, Boston, Mass.

C. B. Breed will continue practice as a consulting engineer in railroad structural and municipal projects, at 6 Beacon street, Boston, Mass.

The firm of H. K. Barrows and C. B. Breed, consulting engineers, has been dissolved, and the two members of the firm, as noted above, will continue their separate business in the same offices as heretofore, at 6 Beacon street.

Edmund F. Saxton, recently assistant director of the Department of Wharves, Docks and Ferries of Philadelphia, and formerly chief engineer of railways and in charge of testing laboratories, has opened offices in the Pennsylvania building, Philadelphia, for practice as consulting engineer in municipal problems, valuations, railways, ocean and river piers and wharves, and will pay special attention to projects in Latin-American countries.

Dr. M. I. Pupin, distinguished electrical engineer and physicist, has been notified by the Academie des Sciences of the Instut de France that the Hebert prize has been awarded to him for his "method of mathematical analysis of electrical circuits, which is today recognized as classical," and for his "discoveries and inventions in electrical resonance, the tuning of electrical circuits and the loading of telephone lines."

Proposed Legislation to Increase Military Training in Colleges

Bills have been introduced in both Houses of Congress to increase the scope of the training and instruction in military science in colleges now having a detail of an army officer for this instruction so as to make the instruction more effective in training men for possible use as officers in a regular or volunteer army in case of need. The proposed law does not interfere with any other bills now before Congress or in contemplation, but proposes simply to enlarge and make more complete and efficient the facilities already offered in this line.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

March 7: Chief of editorial division in Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., at $2,500 a year.

March 7: Mechanical draftsman, Ordnance Department at Large, in Frankford Arsenal, Philadelphia, at $1,320 a year.

March 8: Aid qualified in engineering in Bureau of Standards, Pittsburg, Pa., at $840 a year.

March 15, 16: Ship draftsman in Bureau of Construction and Repair, Navy Department, Washington, D. C., at $4 to $5.04 a day for grade 1, and $3.28 to $4 for grade 2.

March 15, 16: Marine engine and boiler draftsman in machinery division of New York navy yard, at $5.04 a day.

April 12, 13: Laboratory assistant in Bureau of Standards, Department of Commerce, at $900 to $1,200 a year.

War Profits From Garbage

The city of New York may obtain payment for its garbage. The war and the resultant demand for nitroglycerin are given as the reasons for a legal contest which has begun for a contract to remove the garbage of New York City. Altho the city has paid $3,750,000 in seventeen years for removal of its garbage, a company now offers the city $900,000 for that privilege for five years.

Counsel for the new bidder explained why the garbage had suddenly become so valuable by saying that the product of garbage after being treated with steam is grease, the value of which at present is high. From this grease, he said, comes glycerin, from which is made nitroglycerin.

New Sewers for Evanston

An ordinance was recently passed by the Evanston city council granting permission to the sanitary district of Chicago to build an intercepting sewer and branches, thus supplementing the present sewerage system which is said to be inadequate.

The proposed sewer as outlined in the ordinance will consist of a large intercepting sewer in Lake street, which runs east and west, connecting with the drainage canal; a large branch sewer in Orrington avenue, which runs northeast and southwest, and smaller branches in Sherman avenue and in other streets. The estimated cost will be $700,000.

Sanitary District Appropriation

The Sanitary District Board, city of Chicago, announces the contemplated expenditure of $9,072,597 during 1916.

The revenue of the district is estimated at $8,562,800. This is composed of $2,019,103 in cash surplus in the bank at the beginning of the year, $1,062,800 due from the city and payable, according to contract, on or before July 1, next, the proceeds of a $2,000,000 bond issue, and the remainder in taxes and revenue from the hydro-electric plant, rent of dock property and sale of stone and black earth.

A summary of the appropriation, which is printed in the board proceedings, is as follows:

Illinois River Bureau	$ 39,750
Chicago River improvement	730,000
Calumet-Sag Canal	2,000,000
North Shore Canal	90,000
New bridges	483,050
New sewers	2,106,500
Pumping stations	210,300
Other engineering	360,000
Electrical department	774,699
Police department	41,000

Practically all of the work on the Calumet-Sag ditch is being done by contract. Upon the progress of the contractors depends the amount of expenditure from the $2,000,000 set aside for this purpose.

The bridge program includes $105,000 for the Jackson boulevard bridge, $90,000 for the Twelfth street bridge, $247,500 for several bridges across the Calumet-Sag Canal.

Big Chicago Sewer Finished

A big work undertaken by the sanitary district was recently brought to a successful conclusion by the completion of the big north shore intercepting sewer. This diverts from the lake the sewage from the villages north of Evanston and turns it into the north branch of the river. It is seven miles long and its completion removes what was the most serious menace to the health of the people of Chicago and near-by towns which draw their water supply from the lake.

Publications Received

The Massachusetts Bureau of Statistics, established in 1869 as the first of its kind, has issued a sketch of its history, organization and future, with a list of its publications and illustrations of the results of its work. This book was prepared for the Panama-Pacific Exposition exhibit by Charles F. Gettemy, director. The bureau's policy and methods of work were first thoroly established in the early '70's by Carroll D. Wright, and ever since it has been an important source of authentic data upon labor conditions in the state.

Bulletin 257 of the U. S. Department of Agriculture is a contribution from the Office of Public Roads, giving progress reports of experiments in dust prevention and road preservation in 1914. Bulletin No. 249 is on portland cement concrete pavements for country roads, and is by Charles H. Moorefield and James T. Voshell.

The Chicago City Manual, prepared by the Chicago Bureau of Statistics and Municipal Library, is another successful attempt to make a municipal publication popular. It does not give the mass of statistics formerly included in it, and it gives the names of the principal officers in the various departments. Historical and descriptive matter in popular form gives information about parks, duties of various offices, etc.

George G. Earl, general superintendent of the Sewerage and Water Board of New Orleans, has made a brief but comprehensive report of the hurricane of September 29, which was so destructive of property in Louisiana, and of the subsequent heavy rainfalls, which shows what was the efficiency of the pumping plants for drainage which have been put in operation by the board, and what should be done to complete and fortify the system.

The Chamber of Commerce of the United States has prepared a pamphlet giving the reasons in favor of a permanent tariff commission as a national business policy, as voted for by the organizations represented in the body, the vote being 715 for the permanent tariff commission and 9 against it.

The proceedings of the Conference on Valuation, held in November in Philadelphia under the auspices of the Utilities Bureau, are contained in the January number of the *Utilities Magazine*, the bi-monthly organ of the bureau, which is sold at $2, subscription for the year being $5.

Proceedings of the eighth annual convention of the Indiana Sanitary and Water Supply Association. Dr. W. F. King, secretary, Indianapolis, Ind.

"City Planning," with special reference to the planning of streets and lots, by Charles Mulford Robinson, is a revised reissue with much additional material of a book on the width and arrangement of streets, written by Mr. Robinson some years ago. It is eminently practical in its treatment of the subject and pays special attention to methods and results of changing layouts already in use. It is fully illustrated with very pertinent drawings and photographs; 344 pages, $2.50. G. P. Putnam's Sons, New York.

The third volume of Metcalf & Eddy's "American Sewerage Practice," which treats of the disposal of sewage, is issued, completing the most complete American publication devoted to sewerage. It has 851 pages, and its price is $6. It is published by the McGraw-Hill Book Co., New York City.

MACHINERY AND SUPPLIES

Gas-Electric Semi-Trailers

In the motor truck section, appearing in this issue, is illustrated a Couple-Gear dump bottom trailer as used by a prominent New York contracting firm. A similar semi-trailer has a capacity for handling from eight to twelve tons. The power equipment consists of a 4-cylinder 4-cycle 5¾x6 engine and 13-kw. generator, and all of the four wheels under the tractor are power wheels. The forward end of the body being connected by pivot to the frame of the tractor, approximately 65 per cent. of the pay-load is carried upon the rear axle, which is equipped with large steel tired wheels.

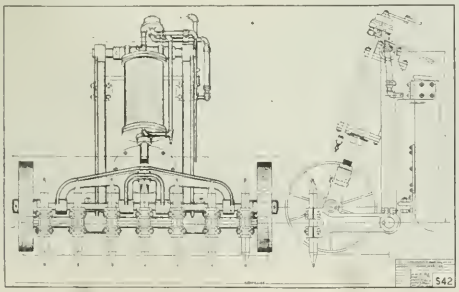
Still another type is of 6-ton carrying capacity, giving from 25 to 35 miles travel from a single battery charge, and discharges its load at the rear by dumping. It is equipped with hand-crank dump. Ninety per cent. of the pay-load is carried on the rear axle. The tires on the rear wheels give 2,000 to 3,500 miles per set, while the rubber traction tires on the forward wheels give us from 7,000 to 10,000 miles.

Pressure Cylinder Scarifier

We are illustrating, in this issue, a pressure cylinder scarifier specially designed for street and road work. The outfit consists of a Kelly-Springfield special steel-built steam or gasoline roller, fitted with seven or more sturdy separate plows or scarifiers, all of which are fastened to and pulled by a common rocking shaft directly attached to the main draw bars by means of a massive steel frame.

This frame contains the entire scarifier, including the two heavy steel rocking shafts, the oscillating compression cylinder, piston and rod, the cross-head fork and the individual scarifier beam or arms.

The road-roller engineer pulls forward the lever controlling the pressure valve and the tool-steel points are forced thru the road surface. The depth and width of cut are controlled by the operator and regulated to suit the exact conditions of the work. The usual width of cut is 6 feet, or the full width of the road roller.



The pressure is applied by means of a swinging cylinder and a reverse pressure is provided for instantly removing the scarifier teeth from the ground. Also, this cylinder pressure insures full elasticity so that the teeth dig to a uniform depth, even on the roughest surfaces. The cylinder further serves as a relief in case of striking solid rocks or other obstacles, and absorbs the shock and vibration on hard work.

The following features are claimed for this new device: One man operates both the roller and scarifier; scarifies the entire width of roller, approximately 6 feet wide, at the regular traveling speed of the roller; enters work instantly upon opening valve lever; raises automatically upon striking hidden obstacles; operator can raise scarifier instantly upon passing over cross walks, manhole covers, etc.; variable depth and width of cut to suit different working condition; scarifier is entirely behind the roller, making every part accessible and giving room for wide clearance when disengaged from work; has separate arm for digging tools, thereby avoiding the usual clogging of materials ahead of tooth bars; direct connected compression cylinder, giving force sufficient for tearing up hardest stone streets and roads and with long stroke to give elasticity required to maintain uniform cutting depth on extremely uneven surfaces.

The above described pressure cylinder scarifier is manufactured by the Kelly-Springfield Road Roller Co., Springfield, O.

New Car Unloader Chute

In a new type of car unloader chute the arms are independent of the pan or tray. The tray is supported by cast steel trunions which drop into slots in the elevators. This type of chute is very simple in its design and no latches or other devices are necessary to retain it in regular position. There are no rivet heads appearing in the pan and the extra bend given at the edge greatly reinforces the tray.

The accompanying illustration gives an excellent view of the working and mechanical operation of this car unloader chute, which has recently been designed and perfected by the Heltzel Steel Form & Iron Works, Warren, O. It combines a number of improvements over the ordinary unloader chute, and is a great saver of time in transferring bulk material, such as sand, gravel, slag and other material from an open freight car to wagons or motor trucks.

The pan or tray is designed to retain a maximum load without spilling, and plenty of clearance is allowed between the car and truck.

The top of the chute is reinforced by means of double angle bends, which also afford a ready handhold, and a clear open end faces the shovelers, the pan being slightly turned up to prevent the material from sifting back into the car.

No lock or device is necessary to hold the chute in position, as the center of gravity is so placed that a 20-pound lift or pull

HELTZEL *car unloader chute.*

will tilt the loaded chute, after which the chute rights itself by gravity.

No bars or rods pass thru the chute, causing interference with the material. Elevated arms, entirely separate from the body, permit the same to be placed independently on the car. To the chute are riveted cast steel trunnions which drop into slots in the elevator supports.

The greatest characteristic of the chute is the lightness thruout, without a sacrifice of strength.

It is shipped and handled complete in three separate parts and is unequaled for ease of moving and putting in place on the side of a car. This is an exclusive and important feature.

Already several hundred of these chutes have been placed on the market with a marked degree of success.

Shallow Excavation by Steam Shovel

We are illustrating Erie steam shovels as used in shallow excavation on state (N. C.) highway work, as well as for similar purpose by Lennane Bros and L. V. Metz.

The following table contains an L. V. Metz record of yardage moved daily on a Pennsylvania state highway contract, Erie to Wesleyville, Pa.

One and one-half cubic yard wagon used—loaded full.

Day	Date-1915	cut	1½-cu. yd. loads per day
Monday	Apr. 12	10-in.	(Started noon)..... 85
Tuesday	Apr. 13	12-14-in.	 342
Wednesday	Apr. 14	12-14-in.	.....*246
Thursday	Apr. 15	16-in.	 447
Friday	Apr. 16	18-in.	 535
Saturday	Apr. 17	18-in.	 528
Monday	Apr. 19	24-in.	 605
Tuesday	Apr. 20	12-in.	 491
Wednesday	Apr. 21	8-in.	 326
Thursday	Apr. 22	12-18-in.	 458
Friday	Apr. 23	12-18-in.	 422
Saturday	Apr. 24	12-18-in.	.....†210
Monday	Apr. 26	12-in.	 422
Tuesday	Apr. 27	12-in.	 426
Wednesday	Apr. 28	12-in.	 449
Thursday	Apr. 29	12-in.	 412
Friday	Apr. 30	12-in.	 416
Saturday	May 1	14-in.	 460

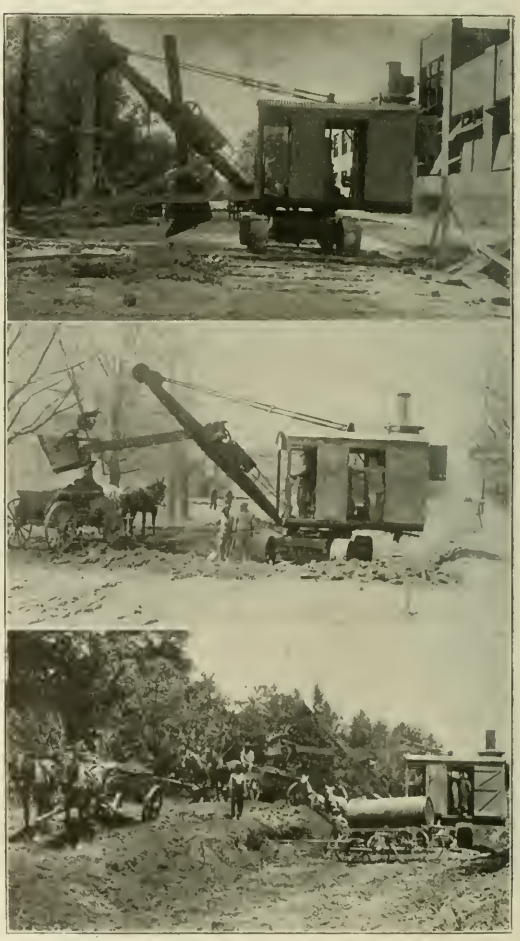
*Two hours lost account water pipes in road.

†Stopped 2 p. m., held up securing water.

The Shore Transfer Co., Winston-Salem, N. C., submit the following record of performance on a type B Erie shovel on a North Carolina highway contract near Winston-Salem, on which the depth of cut ranged from 1 foot to 6 feet:

Date	Remarks	No. 1½-yd. wagon loads	Date	Remarks	No. 1½-yd. wagon loads
6-26-15		424	7- 8-15		555
6-27-15	Sunday		7- 9-15		501
6-28-15		313	7-10-15		502
6-29-15		452	7-11-15	Sunday	
6-30-15		431	7-12-15		486
7- 1-15		551	7-13-15		624
7- 2-15	Rain		7-14-15		514
7- 3-15		761	7-15-15		765
7- 4-15	Sunday		7-16-15	Moving Shovel	302
7- 5-15	Holiday		7-17-15	Rain	
7- 6-15	Rain		7-18-15	Sunday	
7- 7-15		492	7-19-15		407

ERIE SHOVEL *on shallow excavation encountered in road construction.*



7-20-15	367	8- 3-15 Rain	
7-21-15	500	8- 4-15	587
7-22-15	340	8- 5-15	438
7-23-15	818	8- 6-15	411
7-24-15	640	8- 7-15	302
7-25-15 Sunday		8- 8-15 Sunday	
7-26-15	716	8- 9-15	409
7-27-15	730	8-10-15	506
7-28-15	601	8-11-15	485
7-29-15	503		
7-30-15	392	Work completed	
7-31-15 Rain		Total loads 17,328	
8- 1-15 Sunday		Average loads	
8- 2-15	503	per working day...	509

Lakewood "V" Dump Wagon

We are illustrating a type "V" dump wagon which consists of a steel frame fitted on a wagon truck, this steel frame carrying the up-rights and standard "V" dump car body.

In many plants and sand, gravel and clay banks, where it is inconvenient to use cars and tracks, possibly because of steep grades, etc., this style of "V" dump wagon is increasingly popular. In dumping, it throws the load out of the way of the wagon wheels, thus in many cases making it a much more satisfactory dump wagon than a bottom dump wagon,

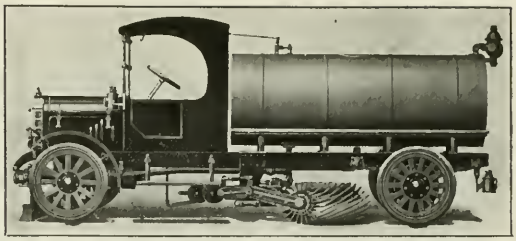
which throws the material under the wheels and makes it necessary for the horses to pull the wagon out over the dumped pile.

As will be noted in the illustration, the contractors have mounted the steel frame, which supports the "V" body, on their own wagon trucks, thus giving the car body the same features as the regulation or standard Lakewood car as regards dumping, locking device, etc. The body, which is furnished by the Lakewood Engineering Co., Cleveland, O., may be locked in a semi-dump position.

Motor "Squeegee" Street Washer

Arrangements have been perfected whereby the Kindling squeegee, mounted on a Sterling chassis, will be featured as the Sterling-Kindling motor squeegee street washer.

This machine consists of a special Sterling worm-driven chassis upon which is mounted a 1,000-gallon oval-shaped steel tank. Placed immediately in front of the front fenders of the chassis are two flusher nozzles controlled by the driver by a lever from his seat. The flusher nozzles by sprinkling the surface of the street prevent the agitation of dust, and also dampen the attached matter so that the squeegee roller can easily force it loose from the pavement and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted immediately behind the front nozzles, the purpose of which is to force aside the large refuse so that it will become suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the center of the chassis frame and immediately underneath is a squeegee or spiral-shaped roller of 19 inches diameter and 8 feet long. Each individual, specially treated rubber spiral is firmly but easily detachable, and mounted in a special kiln-dried wood holder of large wearing surface. And being adjustable as they wear, more fresh surface of the squeegee can be brought into engagement with the street. The squeegee attachment is flexibly mounted and counter-balanced in such a way that when adjusted to a certain pressure, it is impossible for the roller to work loose and the pressure against the surface of the street is uniform, the rubber strips being six inches deep, affording large wearing surface. A toggle joint linkage terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street; and when returning from washing a section of street to lift the roller out of contact with the pavement.



The tank is fitted with a water meter which indicates the amount of water flowing thru it. The water meter serves not only as a safeguad against the squeegee operator's idling and claiming to have squeegeed more street surface than he has, but gives data for calculating the water consumption per square yard for different kinds of pavements, under different conditions, etc. The tank contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.

The Allen Distributer

The Municipal Equipment and Construction Company, Chicago, are marketing a motor-driven outfit known as the Allen distributer, so designed as to enable the chassis to carry any type of body.

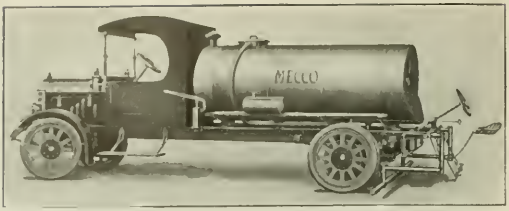
The Allen distributer applies the binder, whether a light dust-laying oil or heavy asphaltic oil, by a pressure spraying device which spreads the oil uniformly over the surface of the road in any quantity required from one-eighth of a gallon per square yard and upward.

All parts of the machine are under the control of the driver, the most important of which is the pressure regulation and gauge which shows the amount of oil being distributed. The temperature is easily controlled and an agitator keeps the warm oil constantly in motion, thus giving an even temperature thruout the tank.

This machine is self-loading, no extra engine being required where heat is already applied to tank or storage cars.

The manufacturers are also furnishing attachments for the connecting of the rear portion of any road sweeper for use in cleaning the roads before applying the oil or binder.

The nozzles are of a new non-clogging type.



The heaters cover a large portion of the tank, the burners being supplied with kerosene from the pressure tank on the side of the apparatus. It is said there is no loss of heat, since the entire heater is lined with asbestos and by a peculiar arrangement of baffle plates the heat is said to be evenly distributed around the tank. The double rotary force-pump, which is positive in its action, is available for either loading or distributing. The distributer pipes are sectional, giving a total width of eight feet.

As the pressure regulator is controlled from the driver's seat and the gage is constantly in view, the penetration is very easily controlled according to pressure. The by-pass agitator is also readily controlled and takes the material from the bottom of the tank, driving it back thru the top, thus insuring an absolute and uniform temperature.

This concern is also building an internal heater machine which is known as the "Mecco," and which is of the same construction as the "Allen" but with internal heating arrangements. This machine can also be furnished with flusher heads in which case the stream is controlled by the rear man. But one man is required to operate the Allen.

These machines are built in 600, 750 and 1,000-gallon capacities.

New Model Pumper.

The city of Independence, Kans., has held its test and has in service its new "South Bend Double Duty" 140-h.p. combination pumping engine and hose carrier.

Three lines of hose, 200 ft. each, were siamesed into one $1\frac{3}{4}$-in. nozzle, throwing a stream 145 ft. in height. These lines were afterward broken into three separate lines, two 1-in.

nozzles and one $1\frac{1}{8}$-in. nozzle, throwing three streams to the top of the Booth Hotel, which is six stories in height, these streams being thrown at a pump pressure of 130 pounds.

This piece of apparatus was then taken to the city reservoir and subjected to a six hours' steady pumping test, maintaining pump pressures of 125 to 275 pounds.

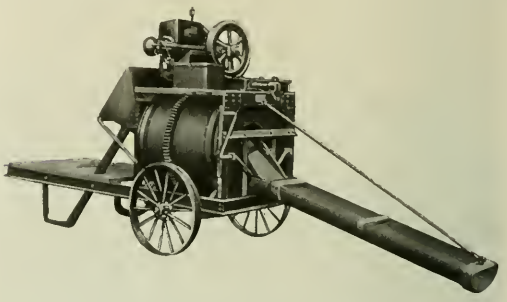
The tests as above described were entirely satisfactory to Mayor Kerr, Fire Chief Pitts, city officials and citizens—all concerned were highly pleased, as the pump more than met the required specifications.

This outfit, which has a hose carrying capacity of 1,200 ft., is equipped with a two-speed transmission rotary geared pump.

After the above tests the pumper, under full load, with five men, 13,000 pounds in all, attained a speed of 55 miles an hour. This piece of apparatus is equipped with Sewell cushion wheels, and was made by the South Bend Motor Car Works, South Bend, Ind. This outfit, which is a distinct departure in certain respects, marks a new era in pumper construction.

Archer Mixer With Paving Chute

We are illustrating an Archer mixer equipped with a road and street paving swing chute, showing the ready adaptability of a mixer of moderate size for paving service by the single attachment of a chute.



This machine, which is made by the Archer Iron Works, Chicago, is equipped with a gear drive thru a single countershaft equipped with a clutch for starting and stopping the mixing drum. All high-speed gears are machine cut and housed.

The charging platform is 5 feet long and 38 inches wide and stands only 21 inches above the ground. Wheelbarrows are wheeled up onto the platform by laying a plank runway on the brace at the end of the platform.

New Type Hose Wagon

The South Bend Motor Car Works have just delivered to the city of Cleveland, O., a straight hose wagon equipped with a 6-cylinder motor developing 90 h.p., which has ample power to carry this car under full load at 45 miles per hour.

It is equipped with dual pneumatic tires in the rear and single pneumatic tires in front. It has a carrying capacity of 1,800 feet of $2\frac{1}{2}$-inch standard rubber-lined fire hose. It has a section with division in this body in case of a large fire for the high pressure hose, which can also be removed for extra hose. This car has been placed in engine house No. 14, which makes an average of four to five calls daily. One of the features of this car is that all nickel trimmings, with the exception of the radiator and bell siren, have been eliminated.

Big Saving Over Wood Forms

When the present extensive road building operations are completed Marion Co., W. Va., will have a system of highways equal to any in the country. The streets are of brick on a concrete base with concrete curb and gutter. The contract for paving over twelve miles of streets just out of Mannington, W. Va., was awarded to the Pietro Paving and Construction Company, of Morgantown, W. Va.

CURVED AND STRAIGHT CURB AND GUTTER CONSTRUCTION BY THE PIETRO PAVING AND CONSTRUCTION COMPANY OF MORGANTOWN, W. VA.

The contractors used wood forms at the beginning of the contract, but soon abandoned them in favor of steel forms. With steel forms, they set over 1,000 feet of curb and gutters a day at a cost of less than fifty per cent. of what would be possible with wood forms. At one time they laid over 400 feet of steel forms and about 160 feet of wood forms. Before placing the concrete, it rained, and the wood forms became so warped they had to be taken up.

The 6-inch Blaw universal rails, bolted together, formed the back of the curb. A single 6-inch rail formed the front of the gutter. The front face of the gutter was formed by a wood face-rail which was removed as soon as the concrete was placed to permit of refinishing promptly. The expansion joints in the concrete were taken care of by dividing plates, which conformed to the design of curb and gutter required. These dividing plates were removed before the side rails and served as templets by which to strike off and finish the curb and gutter. The side rails being slotted every 12 inches, expansion joints can be made wherever desired. In using the Blaw universal rail for this work, the contractors were greatly pleased in that the same rail can be used on sidewalk, curb, curb and gutter, combined base and curb, and concrete roads of all types. No special rails are required.

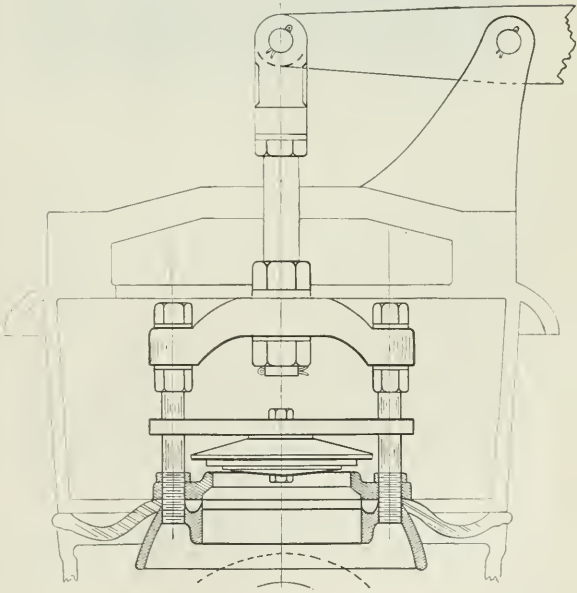
Combinations of straight rails with Blaw flexible rails were used in making most of the curves, tho in many sharp turns it was necessary to use the flexible rails altogether.

Diaphragm Pumps Now Rank With Other Pumps In Efficiency

For many years contractors and others have been using and have been compelled to use, the ordinary diaphragm pump which, operated by hand labor, and with its loose connections and quickly wearing parts, was expensive and very inefficient. With the adaption of the diaphragm pump to use with a gasoline engine it became necessary to strengthen and otherwise improve the pump in order that it might give service in step with the engine. Wear and tear was excessive, the pump splashed badly and the combination caused more or less trouble just at some critical time.

The manufacturers of the Atlantic pumping engine gave early heed to the demand for an improvement and determined to produce a pump that should compare favorably with the Atlantic engine in durability, efficiency and economy. The result was an entire new top head shown in cut, which eliminates every objection to an engine-driven diaphragm pump, besides which a decided increase in the capacity of the pump was secured. The advantages which every user of a diaphragm pump will appreciate may be listed as follows:

Capacity of pump increased more than one-half.



Annoyance of splashing water eliminated.

Positive piston stroke to diaphragm, prolonged life of diaphragm materially and giving full and regular length of stroke.

Rigid fulcrum on pump, avoiding breakage of bolt connection.

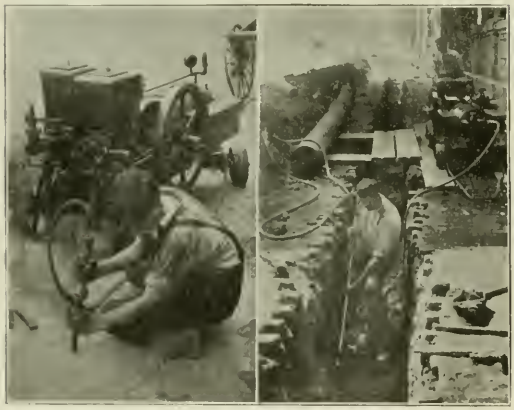
Improved waterway, increasing flow of water to pump, reducing friction and insuring a perfect valve seat.

The result has been to increase the prestige and demand for the Atlantic pumping engines and to persuade contractors to install one of these engines with either a single or a double diaphragm pump on work, where they have previously required pumps either more expensive in installation or in operation. A full descriptive catalog may be obtained by addressing Harold L. Bond Co., 383 M Atlantic Ave., Boston, Mass.

Schramm Compressor Outfit

We are illustrating a Schramm Portable Compressor outfit as used in roughing pavements and tamping back-fill.

For the air supply on larger jobs, it is often very convenient to use a series of smaller units. Contractors, ditchers, excavators and, others who have much work to do as well as structural iron workers, can not always arrange their work so



ROUGHING PAVEMENT AND TAMPING
Back-fill with Schramm Compressor Outfit.

that one compressor unit will do all the work. On most jobs, the demand is comparatively light at the beginning. For this work one of the standard No. 2 units can be used. This gives 21 feet of air and weighs 1,200 pounds. This makes it an easy machine to get on and off of the job and at the same time it will handle many ordinary tools.

Expansion Joint Model 1916

The Pioneer Asphalt Company, Lawrenceville, Ill., has perfected its expansion joint compound. The new product is especially adapted for pavement purposes, possessing all of the desirable features of the 1915 model together with new improvements, which make the joint easy to handle, prevent it from breaking in the coldest weather and permit shipping in more economical and easily-handled packages.

This joint is primarily intended for use longitudinally between gutter and curb in brick, block and wood-block streets and roads, longitudinally and transversely in concrete and granite block streets, transversely in sidewalk construction, along car tracks, around manholes and other surface openings and in concrete bridge construction.

Blawform Bulletin 69

The Blaw Steel Construction Company, of Pittsburgh, Pa., are mailing Bulletin 69 which contains twenty-eight pages of illustrations and descriptions of sidewalk, curb, curb and gutter and road forms; each form described is illustrated.

This bulletin also contains many large halftone illustrations of forms as being placed by prominent contractor concerns thruout the country. Particular attention is called to the illustrations and descriptions of forms for combined base and curb construction, concrete curb construction, combined curb and gutter construction, sidewalk construction, etc.

American Coal Products Company Changes Name to The Barrett Company

It is announced that the American Coal Products Company, well known in connection with the sale of sulphate of ammonia, and parent organization of the even more widely known Barrett Manufacturing Company, has decided to unite the good-will and high reputation of both concerns under the name of "The Barrett Company." The fact that all the roofing, waterproofing and building materials, as well as coal tar, oils, chemicals and similar products are made and widely advertised in the name of the Barrett Manufacturing Company, has added immensely to the good-will attached to the name, which increase has not been connected in the mind of the general public with the securities of the American Coal Products Company, altho this concern owns the stock of the Barrett Manufacturing Company.

The new company will have the same amount of stock as the American Coal Products Company, and the change of name will be accomplished by exchanging all outstanding certificates share for share.

The commercial dealings of the American Coal Products Company included the disposal of ammonia, more especially sulphate of ammonia, which enters largely into the composition of commercial fertilizers and is highly approved as a standard carrier of nitrogen. After February 1 these transactions will be carried on by the same personnel in the name of "The Barrett Company, Ammonia Sales Agency Department." The Agricultural Department, which has carried on propaganda for the use of sulphate of ammonia as a fertilizer, will continue as a department of The Barrett Company.

Branch Managers' Convention Great Success

The week of January 25 and 28 was a notable one for the Trussed Concrete Steel Company, as it marked the first annual convention of the branch managers held at their main plant at Youngstown, Ohio. Men gathered from every section of the country to co-operate in forming improved methods which would render greatest service to their clients. Not only every section of the country was represented, but representatives came from far distant countries, including Japan, Hawaii, South America and Porto Rico. Fully one hundred men were in attendance.

The general program of the convention included business sessions every morning and afternoon. Mr. Julius Kahn, president, gave the opening address, followed by an interesting talk and discussion on "Shop Practice," by T. H. Kane, manager of works. The noon recess was devoted to a thoro inspection of the manufacturing operations with a competent corps of guides to explain all the details.

The subject of "Steel Sash," was ably handled by P. M. Louwerse, manager of the sash department. Many interesting

points dealing with the manufacturers of the various types of sash were brought out, as well as information on stock sash, semi-stock sash and to-order sash. The branch managers entered into the discussion vigorously and told of their experiences in various parts of the country.

On the subject of "Reinforced Concrete" many interesting points in regard to design, systems of construction and local requirements were brought out. R. D. Snodgrass, chief engineer, talked on "Engineering Practice;" B. J. Sigmund, Philadelphia manager, on "The Value of Engineering Service," and Herman Fougner, New York manager, on "Experiences with Reinforced Concrete."

The subject of Hy-Rib and metal lath brought out interesting papers and discussion. Among these were: "Metal Lath," by J. Earle Heber, former Los Angeles manager; "My Method with Distributors," by Louis Baum, Kansas City manager; "Concrete Pavement," with armor plates for protecting the joints, and "Kahn Reinforcement," occupied one of the mornings' session under the leadership of John Bowditch, manager of the highway department. O. W. Chaffee, manager of the credit department, spoke on "Credits and Collections."

The convention closed on Friday afternoon with a talk on general subjects by Gustave Kahn, general manager of sales. Addresses, banquet, supper, theater and motion pictures formed the evening entertainments.

Koehring Salesmen's Convention

Visitors to the recent cement show held in Chicago were aware of the fact that "The Koehring Boys" were at home to all comers.

The Koehring booth was a lively spot in view of the fact that Koehring representatives of all sections of the country were on hand. Each representative wore a special Koehring hat as well as a mammoth badge, giving his name and territory. No matter from what section a contractor or city engineer might come, he was sure to find a Koehring boy whom he knew.

The convention was continued in Milwaukee after the closing of the cement show, with headquarters at the Wisconsin hotel. Demonstrations, business sessions, "speech fests" and banquets made the convention a gala as well as an instructive occasion.

Brownhoist Schnable Bucket

We are showing two views of the Brownhoist Shnable patent drag line bucket as used on the Calumet-Sag Channel of the Chicago drainage canal. These views show the bucket as used by the contracting firms, Shnable & Quinn, Chicago, as well as Byrne Bros. Dredging and Engineering Co., Chicago.

BROWNHOIST SCHNABLE BUCKET *as used on Chicago Drainage Canal construction.*

One of the views shows the bucket beginning to dig. The operator with proper manipulation of the line can pick up a rock larger than the bucket itself, by clamping the rock, as in tongs, between the pulling bail and the digging edge, and this rock then is dumped front wise. Another remarkable service of the bucket is in digging or breaking into rock which has just been blasted, and it serves as a lever in separating the mass.

This bucket, which is of the back-dumping type, consists of a shell, a pulling bail, and a combination hoisting bail and back-gate. In its digging position the pulling bail is connected to the shell at points which are located above the center of gravity of the shell. The pulling bail is also connected by means of links to the hoisting bail and back-gate in such a way that tension on the drag-line forces the gate to close and remain so. When the bucket is suspended on the hoisting bail and the tension on the drag-line is released, the back of the shell tips down away from the back-gate allowing the load to slide and drop out. The pulling bail is connected to the shell by means of bronze sliding blocks carried in slots in the shell. These slots give to the link connections between the pulling bail and the back-gate the required motion to permit the bucket to dump when the tension on the drag-line is released. Special attention is given to flexibility of the bucket and to the prevention of binding in any of the parts by providing loose-fitting connections.

Trade Notes

J. A. & W. Bird & Co., distributers of Ripolin enamel paint, have moved their New York offices to the Equitable building, 120 Broadway. Altho Ripolin is manufactured in Holland,

their stock is large enough to take care of any reasonable demand without increasing the price.

After June 15 the subscription price of *Engineering Record* will be $5 a year.

The headquarters of the Association of American Portland Cement Manufacturers have been removed from Philadelphia to 111 West Washington street, Chicago, Ill.

Trade Publications

Bulletin No. 10 of the Wayeleanse Company, Sandusky, O., shows in detail the construction and mode of operation of their automobile pneumatic street cleaning machine, with gas-electric operating power.

A reprint of a letter by Daniel T. Pierce, executive assistant, the Barber Asphalt Paving Company, Philadelphia, Pa., gives a large number of extracts from court decisions showing the legality of alternate specifications for public work in such states as Indiana, New Jersey, Pennsylvania, Kentucky, Ohio, Michigan, Maryland, New York, and the legal principles involved are applicable in any other state in which specific statutes do not prescribe the exact course of procedure. It will be sent to any one asking for it.

The Christmas card of the C. H. & E. Mfg. Co., Milwaukee, Wis., carries with it holiday greetings and blotters which will extend its message beyond the holiday season.

The Rochester Excavating Machinery Co., Rochester, N. Y., issues an illustrated catalog of the Fogarty excavating bucket, showing it excavating sewer trenches for large and small sewers thru various materials and bracing of trenches, taking gravel out of rivers, excavating for sewage treatment tanks, taking clay from a pit, loading clay on cars, etc.

The Berger Mfg. Co., Canton, O., send full data with photographs of fire tests on metal lumber pressed steel construction: (1) an unofficial test; (2) a test before some sixteen building commissioners and engineers, both made by the Canton laboratories; and (3) an official test by James S. MacGregor and the New York City building bureaus at the Columbia fire testing station, Greenpoint, Brooklyn, N. Y.

"The Asphalt Primer and Colloidal Catechism," issued by The Barber Asphalt Paving Company (Philadelphia) contains in question-and-answer form an easily understood explanation of the principles of colloidal chemistry as applied to the paving industry. An asphalt mixture, it is explained, must be regulated on the basis of the relation of surfaces and films. The presence of colloidal matter, such as has been discovered in Trinidad asphalt, enormously increases the surface area of the aggregate and results in a more closely held and thicker film of bitumen about the particles of the aggregate. In this way is explained the "body" of Trinidad asphalt and the toughness and stability of mixtures in which it is the cementing agent. The Primer is a replica of one of Benjamin Franklin's publications and is illustrated with wood-cuts of ancient and modern highway building.

Water-proofing and damp-proofing, paints for hot and cold water and steam pipes, etc., are quite fully discussed in a publication by the Cohoen Manufacturing Co., Canton, Ohio, entitled *The Scientist*

The Eureka Water Heater Co., Chicago, Ill., are distributing matter advertising the Harding flameless combustion system

Standard specifications for making water-proof and dust-proof concrete floors by the master builders' method are published by the Master Builders Co., Cleveland, Ohio.

Mexpet Record is an occasional publication of the Mexican Petroleum Co., Ltd., which gives beautifully illustrated information as to the properties of the company, its rapidly growing fleet, and the facilities for supplying its products which it is developing in various parts of the country.

The Studebaker oil heater and pressure distributer for oiling roads is described in circular No. 1023 of Studebaker, South Bend, Ind.

The National Concrete Co., Indianapolis, Ind., are distributing a pamphlet on the Listen truss for concrete bridges, showing its application to reinforced concrete girders and slabs.

The Reinforced Concrete Pipe Co., Chicago, Ill., have a handsome new booklet about reinforced concrete, which contains much valuable information about its use aside from the special information about their particular pipe.

The Detroit Board of Commerce publishes a leaflet entitled "Build the Maintenance Into the Road," a policy that satisfies the man who foots the bills, which uses the concrete roads of Wayne county, Michigan, as a concrete example of the truth of the principle.

The Chicago Pneumatic Tool Co. in booklet 224 show the various designs of their pneumatic compressors and fuel oil and gas engines.

The Kinney Manufacturing Co., Boston, Mass., are promoting the Kinney combination auto heater and distributer for bituminous materials, hot or cold, as well as that combination hand spraying tar and asphalt heater.

The Locomobile Company of America send a copy of their instruction book for Locomobile models, which is very complete and is thoroly illustrated and indexed, so that everything in it is available on the moment.

Warren Brothers Company have issued a new catalog of "Warren's Portable Asphalt Plant," which gives full information about this popular design of plant for laying asphalt and other bituminous pavements.

Busch-Silzer Bros. of St. Louis issue separately several handsomely illustrated descriptions and reports of success with Dresel oil engine installations in municipal lighting plants in Estherville, Iowa; Hutchinson, Minn.; Menasha, Wis., and elsewhere.

Warren's portable asphalt plant is the subject of a well-illustrated booklet regarding this interesting piece of paving apparatus, which has been issued by Warren Brothers Company, 142 Berkeley street, Boston, Mass.

The specifications for highway bridges adopted by the American Society for Testing Materials are issued for general distribution to those interested in them by Robert W. Hunt & Co., engineers, Chicago, Ill.

A new edition of Medusa water-proofed white portland cement catalog has been issued by the Sandusky Portland Cement Company, Engineers' building, Cleveland, O., and will be sent on request. It is well worth seeing.

A mono-rail grab bucket crane is shown in a circular of Alfred Box & Co., Philadelphia, Pa.

Harrison Safety Boiler Works, Philadelphia, Pa., have issued a valuable, interesting and handsome book on "Finding and Stopping Waste in Modern Boiler Rooms by the Use of Cochrane Meters."

The Studebaker Corporation, South Bend, Ind., in their serial No. 701, give the advantages of the Studebaker patent improved road oiler for preventing dust and preserving the roads.

The National Concrete Sign and Post Company have for distribution excellent photographic reproductions of sign and guide posts and lamp standards, of which they furnish a number of handsome designs. Their plant is at Grove City and office at Oil City, Pa.

The Pioneer Asphalt Company, Lawrenceville, Ill., has a new illustrated circular on the use of asphalt filler for brick pavements.

The Hollow Building Tile Manufacturers' Association of America, Cleveland, O., publishes a specification for hollow tile wall construction which it suggests for incorporation in municipal building codes.

West Walnut St., Springfield, Mo., showing the old brick pavement before resurfacing with "Tarvia-X".

West Walnut St., Springfield, Mo., showing "Tarvia-X" wearing course over old brick.

Tarvia
Preserves Roads
Prevents Dust

Rejuvenating an old brick pavement—

THIS brick pavement (on West Walnut Street, Springfield, Mo.) was all worn out. The foundation had failed in a number of places, the bricks were broken, the contour was uneven.

A few years ago there would have been nothing to do with it but rip it up and lay another pavement at great expense.

In recent years, however, a remedy has been found for this situation in the use of Tarvia. An old brick pavement like this makes an ideal foundation for a surface of tarvia-concrete and in this case the brick was covered with a wearing coat of three inches of broken stone bonded with "Tarvia-X".

Tarvia has the quality which no other bitumen possesses of adhering readily to cold stone or brick. Accordingly the bond of the surface material to the brick is perfect. The new surface material does not scale off the brick, in fact, this method is a complete success.

At a very moderate cost the city authorities have secured a new pavement and have converted the useless old pavement into a valuable asset.

There are several ways of rejuvenating old brick pavements with Tarvia, and the procedure has been worked out in a number of cities.

Further information on the subject on request.

Special Service Department

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by onyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria
THE PATERSON MANUFACTURING COMPANY, Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

Contracting News

AUTOMOBILES, FIRE APPARATUS AND MOTOR EQUIPMENT.

Arkadelphia, Ark.—Purchase of combination chemical and hose car being considered. M. N. Argicola, Fire Chief.

Carbondale, Pa.—Combination hose and chemical or triple combination fire truck contemplated. J. A. Saxe, City Manager.

Bordentown, N. J.—Motor apparatus will be purchased shortly. W. S. Gington, Fire Chief.

Canandaigua, N. Y.—Bids will be received March 17, for motor-driven fire truck. Wm. N. Brooks, City Clerk.

Canton, S. D.—Installation of new fire alarm system with electrical appliances being planned. Proposals wanted. H. N. Cooper, City Manager.

East Youngstown, O.—Resolution passed providing for purchase of motorized combination hook and ladder and chemical fire truck. Contract awarded Republic Fire Hose Co., for 500 feet double-jacketed flexible fire hose at 80 cents per foot. W. H. Cunningham, Mayor.

Eau Claire, Wis.—One motor truck for water department contemplated. A. R. Garnock, City Manager.

Fogelsville, Pa.—Fire department being organized and equipment may be purchased.

Goshen, Ind.—Until March 6 bids will be received for combination chemical and hose fire truck, cost about $5,000. James W. Haverly, City Engineer.

Goshen, N. Y.—Appropriation will be voted on next month for purchase of motor fire truck. Address Bd. Village Trustees.

Greenfield, Mass.—Motor truck for street department may be purchased this year. Elwin S. Warner, Town Manager.

Hood River, Ore.—Fire alarm system may be installed this year. H. L. Howe, City Recorder.

Jacksonville, Ill.—Bids will be asked at once for auto fire truck. Specification being prepared by J. Edgar Martin, Commr. Public Safety.

Lyons, Kans.—1,000 feet fire hose and chemical wagon and fire truck may be purchased this year. Sam. Ainsworth, City Engineer.

New Haven, Conn.—Purchase of motor truck recommended by Fire Chief Fancher. F. J. Rice, Mayor.

Patchogue, N. Y.—Appropriation of $7,500 for purchase of auto pumping engine will be voted on March 21. Address Bd. of Village Trustees.

Pocantico, N. Y.—Purchase of motor-driven hook and ladder truck will be voted on this spring by North Tarrytown taxpayers. Mr. St. John, Fire Chief.

Plattsburg, N. Y.—Purchase of small tractor for hook and ladder truck planned. Henry J. Langlois, City Engineer.

Rankin, Pa.—City expects to purchase 1 motor-driven fire truck and 1 motor-driven garbage truck. V. G. Duvall, Boro Engr.

Reading, Pa.—$20,000 will be expended on motor apparatus. Mr. Filbert, Mayor.

Rawlins, Wyo.—Purchase of chemical auto apparatus will be voted on in spring. Geo. W. Wirth, City Engineer.

Richmond, Ind.—Three or four companies will be motorized. Fred R. Charles, City Engineer.

Rochester, N. Y.—Complete motorization of fire department is being urged by R. Andrew Hamilton, Commr. of Public Safety.

Roulette, Pa.—Purchase of chemical engine is planned. Address Roulette Chemical Fire Engine Co.

South Orange, N. J.—Purchase of auto pumping engine is being urged by Fire Chief W. E. Campbell.

St. Louis, Mo.—Appropriation of $80,000 is asked for motorizing 6 outlying fire stations. Six engine companies will be equipped with motor combination engines and hose wagons, 2 hook and ladder trucks will be purchased and 5 tractors provided for 5 aerial trucks. Mr. Swinsley, Director of Public Safety.

West Lafayette, Ind.—Fire truck may be purchased this year. Everett B. Vawter, City Civil Engineer.

Williamsport, Pa.—Purchase of motor triple combination chemical, hose and engine truck being considered. Perry S. Harman, Supt. of Public Safety.

Wilmington, N. C.—Purchase of hook and ladder truck being considered. Address Fire Commrs.

BRIDGES.

BIDS REQUESTED.

Alma, Kans.—March 7 until noon, for 41 concrete bridges and culverts in Waubaunsee county. L. B. Burt, County Clerk.

Arcadia, Fla.—March 8 until 2 p. m., for two concrete bridges, spans 60-ft. and 64-ft. A. L. Durand, Clerk, County Commrs.

Cincinnati, O.—March 10 until noon, for concrete bridge on Kugler Mills road, near Allendale. c. e. $500. Fred E. Wesselmann, Pres. Bd. Hamilton County Commrs.

Denison, Tex.—March 6 until 2 p. m., for viaduct across Katy tracks from intersection of Ruck Ave. and Morgan St. to Austin Ave. and Munson St. A. B. Clonny, City Engineer.

Detroit, Mich.—Readvertisement — March 7 until 11 a. m., for temporary pile timber and steel bridge across American channel of Detroit river. c. c. $5,000. Geo. H. Fenkell, Comnr. Public Works.

Hamilton, O.—March 11 until 10 a. m., for bridge over Miami river at Wood and Chestnut Sts., city. F. M. Hamnerle, County Surveyor.

Kansas City, Kans.—March 6 until noon, for Kansas river Central Ave. bridge and approaches. Work includes shifting portion of steel viaduct, removing existing bridge and portions of approaches. Work to be divided into several sections. Harrington, Howard & Ash, Kansas City, Mo., Consulting Engineers.

Kansas City, Mo.—March 10 until 10 a. m., for steel and concrete bridge in Twp. 48, Jackson county. Structural steel required 9,280 lbs. and reinforced concrete 195 cu. yds. c. e. 5% of bid. Allen C. Southern, County Surveyor.

Marshall, Ill.—March 21 until 11 a. m., for bridge work for Parker Twp., Clark county. Estimated cost $4,560. Zane Arbuckle, Supt. County Highways.

Mattoon, Ill.—March 11 until 11 a. m., for reinforced concrete bridge work in Coles and Shelby counties. C. A. Baxter, Co. Supt. Highways, Shelbyville, Ill.

Nashville, Ind.—March 6 until 1 p. m., for 4 steel bridges. Omer Morrison, Auditor Brown County.

Red Oak, Ia.—March 9 until 1 p. m., for 44,830 lin. ft. of 12-in. to 48-in. pipe culverts. Bids to be received on corrugated reinforced concrete, boiler iron and cast iron pipe. Peter Ostrom, County Auditor.

Rockford, Ill.—March 11 until 1:30 p. m., for reinforced concrete bridge work in Harrison Twp., Winnebago county. A. R. Carter, Co. Supt. Highways.

West Palm Beach, Fla.—March 7 until noon, for bridge across St. Lucie river at Stuart, Fla. c. c. 2% of bid. F. E. Encell, Chrmn., Bd. of County Commrs.

CONTRACTS AWARDED.

Albany, N. Y.—Thomas Leonard, Saratoga, lowest bidder for highway bridge over Mohawk river at Little Falls, bid $56,615.

Decorah, Ia.—To Dubuque Boat & Boiler Co., Dubuque, Iowa, 10 "I" beam span bridges with reinforced concrete abutments in county at $14,269.

Elizabethtown, Ky.—To Champion Bridge Co., Wilmington, Ohio, wagon bridge at Woolridge ferry, length 558 feet, at $22,229.

Kingston, Tenn. — To Daugherty-Luten Bridge Co., Nashville, Tenn., concrete bridge across Emory river at Harriman, at $56,400.

North Platte, Neb.—To East St. Louis Bridge Co., East St. Louis, Ill., concrete girder bridge on South Platte St., $16,948.

Papillion, Neb.—To Monarch Engr. Co., Falls City—Gretha State Aid bridge, steel truss bridge, 3 100-ft. spans at $11,843.

Schuyler, Neb.—To Elkhart Bridge & Iron Co., Elkhart, Ind., Schuyler State Aid bridge at $32,000.

Wenatchee, Wash.—To Quigg Constr. Co., city, construction of 500-ft. steel bridge and about 1 mile permanent highway in county, at $38,945.

CONTEMPLATED WORK.

Anamosa, Ia.—County will call for bids in March for 25 bridges. Steel structures on concrete abutments, concrete floors. J. F. Whalen, County Engineer.

Belleville, Ill.—Five reinforced concrete concrete bridges. W. C. Wolf, City Engr.

Hermosa Beach, Cal.—Viaduct will be constructed this year. C. R. Sumner, City Engineer.

Kansas City, Mo.—Bond issue of $450,000 voted for small bridges and $300,000 for 23rd St. trafficway and viaduct. Clark B. Mandigo, Asst. City Engineer.

Lambertville, N. J.—New bridge on South Union St. planned by Hunterdon county. Grant Davis, County Engineer, Whitehouse, N. J.

Mankato, Minn.—Concrete bridge of 5 arches each 90-ft., roadway 32-ft. with 2 6-ft. walks. H. F. Blomquist, City Engr.

Marshalltown, Ia.—One 3-40-ft. deck girder concrete bridge. To be erected by city and county. W. H. Steiner, City Engr.

Monroe, Minn.—$60,000 appropriated for 2 bridges. A. H. A. Kutsche, City Engr.

Norwood, O.—Three concrete bridges. John G. Schmidt, City Engineer.

Topeka, Kans.—Two reinforced concrete bridges, to cost about $25,000. A. R. Young, City Engineer.

Woonsocket, R. I.—Two small bridges. Appropriation $10,400. Frank H. Mills, City Engineer.

BUILDINGS.

BIDS REQUESTED.

Huntington, Ind.—March 17 until 10 a. m., for erection of high school building, c. c. $5,000 for building contract. Separate bids will be received for plumbing, heating, etc. Elmer E. Dunlap, Archt., 909 State Life Bldg., Indianapolis, Ind. E. E. Allen, Pres. Board of School Trustees.

Kansas City, Mo.—March 7 until 2 p. m., for general contract for building for park department which includes brick, concrete, carpenter, plumbing, heating, sheet metal and roofing. A. C. Harrington, Secy. Bd. Park Commissioners.

New Orleans, La.—March 22 until noon, for addition to building, plumbing station No. 3 (Contract 76-D). Deposit $100. F. S. Shields, Secy., Sewerage & Water Bd.

North Bend, Wash.—March 10 until noon, for brick school building. Separate bids for heating and plumbing. Edgar Boalch, Clerk, Board of Directors.

LIGHTING.

BIDS REQUESTED.

Berwyn, Ill.—March 21 until 8 p. m., for installation of ornamental lighting system in business district and lighting system in new sub-divisions. Estimated cost $15,000, c. c. 10% of bid. B. C. Strutzenberger, City Engineer.

Elwood, Ind.—Until March 20, for city street lighting contract for period of 10 years. Address Lighting Comm. of Council.

Woodbury, N. J.—March 7 until 8 p. m., for furnishing and installing electric light plant at Woodbury pumping station on Mantua Creek. c. c. $100. Arthur Starr, City Clerk.

CONTRACTS AWARDED.

Claude, Armstrong County, Tex.—To Nelson & Smalley, city, installation of electric light plant.

Ottawa, Kans.—To I. C. Bushong Electrical Works, city, installation of White Way lighting system, at $7,131.

CONTEMPLATED WORK.

Albion, N. Y.—20 ornamental light standards and 25 lamps. Address Village Pres.

Alexandria, Ind. — Ornamental lighting system being considered. R. H. Malone, City Clerk.

Anderson, Ind.—Ordinance passed for improvements to municipal light plant. Estimated cost $100,000. E. Funk, City Engr.

Alpena, Mich.—20 ornamental light standards and 20 lamps of 110 volts. Jos. W. McNeil, City Engr.

Bellefontaine, O.—101 ornamental lighting standards and lamps of 600 c. p. Claire A. Inskeep, City Engr.

Carbondale, Pa. — Ornamental lighting system under consideration. J. A. Saxe, City Engineer.

Chicago Junction, O.—Movement started for installation of ornamental light standards. E. K. McMorris, Corp. Clerk.

Colusa, Cal.—20 ornamental light standards and 40 lamps will be installed. J. W. Kaerth, City Engineer.

BITULITHIC

The Pavement which has Proven to be "Best By Every Test"

The **Bitulithic** Pavement, Colonial Ave., Norfolk, Va.

The Greatest care is used in the mixing and laying of the **Bitulithic** pavement. It renders unfailing service.

Bitulithic is constructed for all kinds of traffic. It is composed of varying sizes of the best stone obtainable combined with bituminous cement and laid under close laboratory supervision.

The integrity of the construction of **Bitulithic,** and the satisfaction of municipalities which have and are still using it, far outweigh any saving in first cost.

In these days of frenzied competition in the paving field, we believe this declaration of principle is needed. And our reputation of many years' standing in the street paving industry will back it up.

Bitulithic can be laid as satisfactorily over sound macadam foundation as over concrete foundation.

Bitulithic is the development of many years' experience in road building. We are paving specialists and give you the benefit of our experience.

Bitulithic Pavement is the cities' best asset—as you will have a well-paved street for years to come.

No Time Like the Present to Specify **Bitulithic** for streets to be paved this spring. The sooner you award your contract for **Bitulithic** the earlier your streets will be ready for use.

Bitulithic is the delight of all automobilists, abutting residents and taxpayers.

"BITULITHIC—the Pavement of Quality"

A postal card will bring you illustrated booklets regarding **Bitulithic Pavement.**

Why not write one today to

Warren Brothers Company

Executive Offices: BOSTON, MASS.

DISTRICT OFFICES:

NEW YORK, N. Y. 50 Church St.
CHICAGO, ILL. 10 S. LaSalle St.
ROCHESTER, N. Y. 303 Main St., W.
LOS ANGELES, CAL. 926 Calif. Bldg.
PORTLAND, ORE. Journal Bldg.
PHOENIX, ARIZ. 204 Noll Bldg.
NASHVILLE, TENN. 606 Independent Life Bldg.
RICHMOND, VA. Virginia Railway & Power Bldg.
ST. LOUIS, MO. Railway Exchange Bldg.

Contracting News

Crown Point, Ind.—10 ornamental light standards, 30 lamps of 100 v. F. L. Knight & Sons, Engineers.

Deer Lodge, Mont.—Probably 100 ornamental light standards will be installed. H. B. Grant, City Engineer.

Dothan, Ala.—Extension of White Way contemplated. Geo. E. Heller, City Engr.

East St. Louis, Ill.—Bids will be asked shortly for light plant for supplying current for new high school, old high school and Horace Mann school. Address Board of Ed.

Eaton Rapids, Mich.—20 ornamental light standards and 20 lamps contemplated. I. R. Ellison, City Engineer.

Gastonia, N. C.—Installation of 63 ornamental light standards and lamps of 600 c. p. planned. H. Rutler, Supt. Pub. Works.

Greenwood, Miss.—Installation of White Way being planned. Address City Council.

Havelock, Neb.—15 or 16 ornamental light standards. O. W. Barnes, City Engr.

La Crosse, Wis.—10 or 12 ornamental light standards and 5 lamps, each 80 to 100 amp. Geo. P. Bradish, City Engr.

Ludington, Mich.—19 ornamental standards and 3 lamps. Geo. W. Clark, City Engr.

Lyons, Kans.—16 ornamental light standards will be installed. Sam. Ainsworth, City Engineer.

Manchester, Ia.—75 ornamental light standards and 165 lamps of 110 v. F. Wilson, City Engr.

Paris, Tenn.—Ornamental light standards being considered. M. W. Younkin, Secy., Board of Public Works.

Raton, N. Mex.—Installation of municipal lighting plant will be voted on in April. George R. Fryman, Supt. Water Works and Engineer.

Ridgewood, N. J.—75 ornamental light standards and 75 lamps of 60 c. p. will be installed. F. W. Simonds, City Engineer.

Seymour, Ind.—Merchants contemplate installing ornamental lighting system. Address Nathan Kauffman. John R. Ross, Mayor.

Unoln City, Ind.—60 ornamental light standards will be installed. H. P. McKown, Civil Engineer.

Wallingford, Conn.—White Way on Main St. proposed. $3,000 appropriated. A. L. Pierce, Supt. Electric Light Plant.

Warsaw, Ind.—Ornamental light standards under consideration. Geo. W. McCarter, City Engineer.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Arcadia, Fla.—March 7 until 10 a. m., for 20,000 sq. yds. asphalt pavement. A. S. Jaudon Engr. Co., Engrs., Bartow, Fla. A. L. Durrand, Clerk, County Comrs.

Atlantic City, N. J.—March 8 until 11 a. m., for constructing Ascot-Atlantic City Blvd. Work includes construction of one girder bridge and one bascule bridge. c. c. $1,000. A. H. Nelson, Engr., Atlantic County.

Beloit, Wis.—March 14 until 2 p. m., for 97,000 sq. yds. paving, 55,000 lin. ft. combined curb and gutter and 600 lin. ft. covered gutter on various streets. Bids to be received on following types of pavement: vitrified block, sheet asphalt, asphaltic concrete, 1-course reinforced concrete. All on 5-in concrete base. Geo. P. Hayes, Chrm. Public Works Commission.

Bloomfield, N. J.—March 20 until 8 p. m., for 2,600 lin. yds. 5x15-in. bluestone curb and 870 sq. yds. trap rock gutter pavement on Glenwood Ave. and 470 sq. ft. 5-in. concrete walk on Davy St. c. c. $200 and $50. Raymond F. Davis, Town Clerk.

Bluffton, Ind.—March 11 until 10 a. m., for one brick street in city, to cost $27,-752.75; asphalt street in city to cost $13,321.93; 8 stone roads in county, to cost from $3,134.55 to $16,514.64, and 1 macadamized road in county to cost $5,162. C. T. Kain, Auditor, Wells County.

Burlington, N. C.—March 9 until 2:30 p. m., for 25,000 sq. yds. street pavement, 7,560 ft. combined curb and gutter and 4,000 lin ft. street railway track pavement. J. E. Moore, Mayor. Edward W. Myers, Consult. Engr., Greensboro, N. C.

Camden, N. J.—March 6 until 11 a. m., for granite and bituminous surface upon concrete foundation on Moorestown Turnpike. Estimated amount of pavement 29,-637.54 sq. yds. c. c. $1,000. Fred W. George, Clerk, Bd. Chosen Freeholders, Camden County.

Cincinnati, O.—March 7 until noon, for granite curbs and asphalt pavement on Back St., from Hammer to Walnut St. c. c. $400. Chas. F. Hornberger, Director Pub. Service.

Columbus, Ind.—March 18 until 10 a. m., for grading, draining and paving Thompson road with gravel and crushed stone with bituminous binder. W. H. Scott, County Auditor.

Crown Point, Ind.—Until March 16, for 66,500 sq. yds. oiled streets. F. L. Knight & Sons, City Engineers.

Forest City, Iowa.—March 15 until 8 p. m., for 25,500 sq. yds. pavement and 16,500 lin. ft. combined curb and gutter. Bids will be taken on following pavement: Portland cement concrete, asphaltic concrete, Barber and Independent asphalts, brick block, 2½ and 3-in. vertical fiber brick, bituminated concrete, bitulithic, sheet asphalt, Barber and Independent. c. c. $500. Theo. S. De Lay, Consult. Engr., Creston, Ia. G. B. Chryst, Town Clerk.

Goshen, Ind.—March 6 until 8 p. m., for 36,000 sq. yds. pavement on Third and Seventh Sts. Materials: Sheet asphalt, brick, asphaltic concrete and bitulithic. Also 1,600 lin. ft. concrete curbing and 15,000 lin. ft. comb. curb and gutter. c. c. 2½ of estimated cost. James W. Haverly, City Engr.

Hastings, Neb.—Until March 13, for about 173,985 sq. yds. paving and 98,070 lin. ft. combined curb and gutter. Bids to be received on various kinds of pavement. Mr. Fuller, City Engr. Wm. Madgett, Mayor.

Indianapolis, Ind.—March 10 until 10 a. m., for concrete road in Center Twp., Marion county. Leo K. Fesler, Co. Aud.

Irvington, N. J.—Until March 22, for 8,000 sq. yds. concrete bit. top pavement and 6,800 lin. ft. bluestone curbing. I. J. Casey, Jr., Town Engineer.

Kansas City, Mo.—March 7 until 2 p. m., for concrete single curb on both sides of Swope Parkway and bituminous macadam pavement on various streets. T. C. Harrington, Secy. Bd. Park Commissioners.

Kearney, Neb.—March 8 until 3 p. m., for paving District No. 11, about 14,000 sq. yds. Materials to be considered: Vertical fiber brick with concrete base and asphalt filler, asphalt concrete, cement concrete, monolithic brick, repressed brick block pavement, sheet asphaltic simplex fiber brick asphalt filler. c. c. 5 of bid. T. N. Hartzell, City Clerk.

Madison, Ind.—March 6 until 7 p. m., for about 14,000 sq. yds. asphaltic, concrete, vitrified brick or creosoted wood block pavement. Estimated cost $41,000. c. c. 2½ of estimate. Harry E. Nichols, City Clerk.

Maysville, Ky.—Until March 6, for 16,000 sq. yds. sheet asphalt and 25,000 sq. yds. brick pavement, also 15,000 lin. ft. concrete curbing. W. T. Glazier, Engr., Newport, Ky.

Muncie, Ind.—March 18 until 10 a. m., for stone road in Delaware Twp., Delaware county. Jas. E. Williams, County Auditor.

Oak Park, Ill.—March 7 until 4 p. m., for granite combined curb and gutters, grading and paving with asphaltic concrete, on 6-in. Portland cement concrete foundation, sewers, catchbasins and manholes in Home Ave. and Clinton Ave. c. c. 10 of bid. B. C. Brandstadt, Secy. Bd. of Local Improvements.

Ontario, Cal.—March 13 until 7:30 p. m., for about 512,000 sq. ft. concrete paving with asphaltic oil and sand surface and about 35,000 lin. ft. cement curbing on San Antonio Ave. R. O. Brackenridge, City Clk.

Peoria, Ill.—March 6 until 2 p. m., for brick pavement on New York Ave. About 2,620 sq. yds. pavement, and 1,450 lin. ft. sandstone curb, etc. c. c. 10 of bid. Sherman W. Eckley, Pres. Bd. of Local Improvements.

Revere, Mass.—April 3 until noon, for about 4,500 sq. yds. granolithic sidewalk. c. c. $100. Carl G. Richmond, Supt. Public Works.

Sioux Falls, S. D.—Until March 15 for ten paving contracts covering total of 54 blocks of streets. S. B. Howe, City Engr. Walter C. Leyse, City Auditor.

Winchester, Tenn.—March 15 until noon, for about 125 miles macadam roads in Franklin county. Bond issue $359,000. S. S. Swan, Chrm., County Highway Comm.

CONTRACTS AWARDED.

Baltimore, Md.—To American Paving Co., city, sheet asphalt pavement, 3 contracts, at 96 cents per sq yd., or totals of 770,883, $64,121 and $104,883; to Baltimore Asphalt Rock & Tile Co., city. Contract No. 128, sheeto asphalt pavement, at $57,119.

Brackettville, Tex.—To W. H. Davis, San Antonio, Tex., grading and macadamizing 10 miles Brackett-Spofford Road at $21,830.

Chicago Heights, Ill.—To Chicago Heights Coal Co., city, paving of 22nd St. at $2.06 per sq. yd.

Denison, Ia.—To M. L. Flynn Paving Co., 57,000 sq. yds. concrete pavement at $1.27½ per sq. yd.

Duluth, Minn.—To Olson & Johnson, city, brick or concrete pavement on Grand Ave. Bids: Brick $171,362, and concrete, $138,993.

Los Angeles, Cal.—To Coast Construction Co., S. Hill St., city, concrete pavement on Artesia Ave. at $18,572.

Monroeville, Ind.—To Ellison & Co., Monroeville, macadam road in Eel River Twp., Allen county, at $12,125.

Monroe, Mich.—To Harry Vanderveen, Grand Rapids, 2-in. Bermuda asphaltic concrete pavement on 5-in; concrete base with concrete marginal curb, on Monroe-Toledo highway at $173,500.

Seattle, Wash.—To Coluccio & Niblett, Seattle, 31,200 sq. yds. concrete pavement on 35th Ave. at $43,480.30.

St. Cloud, Minn.—To Minneapolis Bridge Co., Minneapolis, creosoted block pavement on 10th St. bridge, at $5,825.

West Liberty, Ia.—To the McNamara Construction Co., Dubuque, Ia., paving contract amounting to about $100,000. Bid: $1.83 per sq. yd. for Purington brick No. 1, on 5-in. concrete base with asphalt filler; $1.75 per sq. yd. for No. 1 Purington brick on 4-in. concrete base and $1.64 for No. 2 Purington brick with 4-in. concrete base.

CONTEMPLATED WORK.

Albion, N. Y.—10,000 sq. yds. brick, 5,000 sq. yds. stone pavement, 10,000 sq. yds. gravel and 43,500 sq. yds. oiled streets, 1,000 sq. yds. concrete sidewalks and 150,000 sq. yds. sandstone curbing. Address Village Pres.

Alpena, Mich.—Probably 15,000 sq. yds. concrete pavement, 3,800 yds. concrete sidewalks and 5,000 lin. ft. concrete curbing. Jos. W. McNeil, City Engineer.

Anamosa, Ia.—One mile brick block pavement on concrete base and 6,000 lin. ft. combined curb and gutter. J. F. Whalen, Co. Engr.

Ann Arbor, Mich.—15,000 sq. yds. pavement. Kind not determined. Manley Osgood, City Engr.

Battle Creek, Mich.—8,000 sq. yds. brick and 50,000 sq. yds. asphaltic concrete pavement, 15,000 sq. yds. concrete sidewalks and 20,000 to 25,000 lin. ft. comb. curb and gutter. Edward Hoyt, Asst. City Engr.

Belleville, Ill.—124,000 sq. yds. concrete pavement, and 55,500 lin. ft. concrete curbing. W. C. Wolf, City Engineer.

Blackfoot, Ida.—50,000 sq. yds. granite or stone block pavement, and 5,000 lin. ft. concrete curbing. Jas. Young, City Engineer.

Bloomfield, N. J.—40,000 sq. yds. concrete bituminous top, 2,500 sq. yds. bituminous concrete pavement, 1,600 sq. yds. concrete sidewalks, 20,000 lin. ft. bluestone curbing and 40,000 lin. ft. comb. curb and gutter. Ernest Baechlin, Town Engineer.

Bloomsburg, Pa.—About 12,000 sq. yds. brick pavement on 5th St. W. H. Eyer, City Engineer.

Boise, Ida.—Probably $100,000 to $200,000 will be expended for pavements in city. Bond issue of $20,000 will be voted on shortly for road construction in Ada county. E. G. Eagleson, City Engineer.

Bristol, Tenn.—30,000 sq. yds. concrete pavement, 2,000 sq. yds. concrete sidewalks and 8,500 lin. ft. concrete curbing. S. G. Keller, Commr. of Public Improvements.

Bucyrus, O.—100,000 sq. yds. brick or clay pavement. F. L. Niederheiser, City Engineer.

Burlington, Wis.—Bids will be called soon for 8,100 sq. yds permanent pavement (type not selected). J. Hurtgen, City Engr.

Carbondale, Pa.—25,000 sq. yds. brick or clay, 2,000 sq. yds. granite or stone, and 3,000 sq. yds. bitumen, macadam pavement; 42,000 lin. ft. flagstone sidewalks and 35,000 lin. ft. sandstone curbing. J. A. Saxe, City Engineer.

Crown Point, Ind.—10,000 sq. yds. bituminous macadam pavement under consideration. F. L. Knight & Sons, City Engrs.

Eldorado, Ark.—Paving district formed and about 26,000 sq. yds. pavement will be

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We Are Prepared

Within the wide boundaries of our country, embracing more than three million square miles, dwell a hundred million people.

They live in cities, towns, villages, hamlets and remote farms. They are separated by broad rivers, rugged mountains and arid deserts.

The concerted action of this far-flung population is dependent upon a common understanding. Only by a quick, simple and unfailing means of intercommunication could our people be instantly united in any cause.

In its wonderful preparedness to inform its citizens of a national need, the United States stands alone and unequaled. It can command the entire Bell Telephone System, which completely covers our country with its network of wires.

This marvelous system is the result of keen foresight and persistent effort on the part of telephone specialists, who have endeavored from the first to provide a means of communication embracing our whole country, connecting every state and every community, to its last individual unit.

The Bell System is a distinctly American achievement, made by Americans for Americans, and its like is not to be found in all the world.

Through it, our entire population may be promptly organized for united action in any national movement, whether it be for peace, prosperity, philanthropy or armed protection.

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Contracting News

constructed. Ford & MacCrea. Engrs., Gazette Bldg., Little Rock, Ark.

Eveleth, Minn.—9,000 sq. yds. paving, either bitulithic or creosoted blocks on 6-in. concrete base will be let about May 1. C. M. Dorway, City Engr.

Frankfort, Ky.—About 60,000 gals. road oil will be used this year. W. S. Polsgrove, Superintendent Streets.

Freeport, Ill.—30,000 sq. yds. brick or clay pavement, 8,000 sq. yds. bituminous macadam and 20,000 sq. yds. other pavement, 4 miles oiled streets, 2 miles concrete sidewalks and 40,200 lin. ft. comb. curb and gutter. Work to be advertised in May. Chas. S. Hepner, City Engineer.

Hermosa Beach, Cal.—16,000 sq. yds. concrete bit. top and 25,000 sq. yds. asphaltic concrete pavement. C. R. Sumner, City Engineer.

Lake Forest, Ill.—16,700 sq. yds. brick or clay block, 13,700 sq. yds. concrete, and 5,526 sq. yds. Portland cement concrete pavement, and 20,526 lin. ft. combined curb and gutter. Jas. Anderson, Jr., City Engineer.

Madison, S. D.—About 35,000 sq. yds. pavement and 10,000 lin. ft. combined curb and gutter will be let this year. Chas. A. Trimmer, City Engineer.

Manitowoc, Wis.—20,000 sq. yds. oiled streets, and 5,000 lin. ft. combined curb and gutter. L. K. Pitz, City Engineer.

Minneapolis, Kans.—19,043 sq. yds. brick pavement. G. P. Crosby, City Engineer.

Moline, Ill.—Bids will be advertised in April for 36,000 sq. yds. sheet asphalt pavement, 7,519 sq. yds. brick or clay pavement and 24,500 sq. yds. concrete sidewalks. Also 31,000 lin. ft. combined curb and gutter. Lyle Payton, City Engineer.

Moscow, Idaho.—25,000 sq. yds. sheet asphalt pavement will be advertised about April 15. H. J. Smith, City Engr.

Muncie, Ind.—23,862 sq. yds. sheet asphalt, creosoted wood block, brick or clay block or concrete pavement, 1,982 lin. ft. comb. curb and gutter. B. F. Deardurff, City Engr.

Newark, Ohio.—About 25,000 sq. yds. pavement will be advertised about April 1. Open specifications, but brick is favored. C. H. Wells, City Engr.

Norwood, Ohio.—21,000 sq. yds. creosoted wood block, 25,000 sq. yds. brick, 32,000 sq. yds. granite and 10,000 sq. yds. bituminous macadam pavement, and 160,000 sq. yds. oiled streets. Work to be let in 60 to 90 days. John G. Schmidt, City Engr.

Rawlins, Wyo.—About 60,000 sq. yds. oiled streets. C. W. Wirda, City Engr.

Rensselaer, N. Y.—12,600 sq. yds. brick or clay block pavement, 5,700 sq. yds. concrete sidewalks and 10,870 lin. ft. concrete curbing. L. Greenalch, City Engr.

Richmond, Ind.—12,000 sq. yds. sheet asphalt, 12,000 sq. yds. brick or clay, 101,000 sq. yds. concrete and 1,000 sq. yds. bituminous macadam pavement. Also 5,000 lin. ft. combined curb and gutter. Bids will probably be asked in March or April. Fred R. Charles, City Engr.

Rockford, Ill.—Contract will be let in about 6 weeks for 52,000 sq. yds. brick or clay pavement, 26,000 sq. yds. water bound macadam pavement and 44,000 lin. ft. comb. curb and gutter. Edwin Main, City Engr.

Scranton, Pa.—25,847 sq. yds. sheet asphalt and 7,253 sq. yds. stone pavement. Work to be let in March. Wm. A. Schunk, Chief Engr.

Seattle, Wash.—Plans approved for paving Warren Ave. with brick block at cost of $13,112, for grading 60th Ave. S. W. at about $7,000 and for paving W. McGraw St. with brick block and asphalt at about $110,000. A. H. Dimock, City Engr.

Seward, Nebr.—Plans will be out in April for 30,000 sq. yds. pavement. Material not decided on yet. Bids will be received in April or May. Also 8,000 lin. ft. concrete curbing included. John Martz, City Engr.

Sioux City, Iowa.—10,000 sq. yds. sheet asphalt pavement, 250,000 sq. yds. concrete, 5,000 sq. yds. concrete sidewalks and 10,000 lin. ft. concrete curbing planned for 1916. A. H. Johnson, City Engr.

South Milwaukee, Wis.—Bids will be called soon, for 11,500 sq. yds. brick, sheet asphalt and reinforced concrete pavement, and 2,000 lin. ft. comb. curb and gutter. P. J. Hartgen, City Engr., Burlington, Wis.

Steubenville, Ohio.—12,000 sq. yds. brick or clay pavement, 8,000 sq. yds. concrete sidewalks, 4,000 lin. ft. concrete curbing, and 8,000 lin. ft. combined curb and gutter will be advertised about May. J. N. Leech, City Engr.

Utica, N. Y.—$144,000 appropriated for asphaltic concrete and bitulithic pavement. Work to be advertised in March.

Washington, Ind.—21,000 sq. yds. concrete sidewalks, and 2,100 lin. ft. comb. curb and gutter. Hugh F. O'Neall, City Engr.

Woonsocket, R. I.—163,787 sq. yds. granite or stone block pavement, 9,940 sq. yds. concrete pavement and 43,650 sq. yds. bituminous macadam pavement. About 100,000 gal. road oil required for street oiling. Frank H. Mills, City Engr.

SEWERS.

BIDS REQUESTED.

Bad Axe, Mich.—March 8 until 7:30 p. m., for sewer system and sewage disposal plant. James A. Burgess, City Recorder; R. W. Roberts, Engr., Saginaw, Mich.

Canby, Minn.—March 20 until 8 p. m., for 950 lin. ft. sewer extension. J. H. Gehbauer, Secy. Bd. Engr.

La Crosse, Wis.—Until March 9, for extension of trunk sewer, estimated to cost $42,186. Geo. P. Bradish, City Engr.

Madison, Ill.—Bids will be asked April 1 to April 10, for 35,000 lin. ft. vitrified tile sewers. Appropriation $155,000. W. Champion, Secy. Bd. Local Improvements.

Springfield, Ill.—March 21 until 10 a. m., for sewage treatment plant at St. Charles school for boys. Address Bd. of Administration, Capitol Bldg., Springfield.

CONTEMPLATED WORK.

Bozeman, Mont.—City will probably let contract this year for $200,000 water and sewer systems. Bonds will be voted on shortly. Carl C. Widener, City Engr.

Columbia, S. C.—$150,000 bonds issued for sewer extensions. Plans not completed. Size of sewers range from 8 in. to 18-in. John McNeal, City Engr.

Dayton, Ohio.—60,875 lin. ft. 5-in. to 24-in. vitr. tile sewers and 60,000 lin. ft. concrete sewers will be advertised about April 1.

Elmira, N. Y.—13,000 lin. ft. vitr. tile sewers, size 10-in., and 800 lin. ft. 12-in. vitr. tile sewers. Thurber A. Brown, City Engr.

Lodi, N. J.—Bond issue of $200,000 will be voted on March 28 for sewer system and sewage disposal plant. Bowe & Wessells, Consult. Engr., Rutherford, N. J.

Murphysboro, Ill.—Plans completed for sewer system for northwest part of city. Estimated cost, $32,000. Bids will be asked shortly. R. A. Riolo, Consult. Engr.

New Carlisle, Ohio.—36,000 lin. ft. vitr. tile sewers 8-in. to 18-in., will be let about May 1. D. Earl Beattie, City Engr.

Norwood, Ohio.—10,000 lin. ft. vitr. tile sewers and 3,000 lin. ft. segment block sewers. Sizes 15-in. to 30-in. and 36-in. to 60-in. John G. Schmidt, City Engr.

Rexburg, Idaho.—Municipal sewer system being considered. Probable cost $50,000. Bond issue will be voted on shortly.

Revere, Mass.—$20,000 will be expended for vitr. tile sewers. Work will be advertised about May 1. Carl G. Richmond, City Engr.

Shreveport, La.—About 27 miles sewer extensions and sewage disposal plant contemplated. E. M. Turner, City Engr.

Sioux City, Iowa.—25,000 lin. ft. 8-in. vitr. tile sewers planned. T. H. Johnson, City Engr.

Summitt, Miss.—Sanitary sewer system and sewage disposal plant to be installed. Estimated cost $75,000 to $100,000. C. F. Sherman, City Engr.

Taylorville, Ill.—About 16,000 lin. ft. vitr. tile sewers and 6,000 lin. ft. segment block sewers will be advertised about May. Plans being prepared for sewers and drains for north and west portions of city, to cost about $55,000. J. W. Dappert, City Engr.

WATER WORKS.

BIDS REQUESTED.

Florence, Ore.—Until March 20, for sinking 20 well points and for bldg. pump house. Address D. E. Severy, City Recorder.

South Boston, Va.—March 30 until 8 p. m., for water works improvements including pumping station, filter plant, force mains, reservoir, filter plant equipment, etc. C. c. 5 per cent. of bid. W. L. Penick, Mayor. Anderson & Christie, Consult. Engrs., Charlotte, N. C.

Wilson, N. C.—March 27 until 4 p. m., for water works improvements, consisting of filter bldg., pump room, extension to present brick and concrete power station, coagulation basin, reservoir, etc. C. c. 5 per cent. of bid. E. F. Willette, Mayor. Anderson & Christie, Consult. Engr., Charlotte, N. C.

CONTEMPLATED WORK.

Battle Creek, Mich.—10,000 to 15,000 lin. ft. 6-in. to 18-in. cast-iron water mains planned. Edward Hoyt, Asst. City Engr.

Columbia, S. C.—$200,000 bonds issued for water main extensions. Sizes range from 6-in. to 12-in. John McNeal, City Engr.

Florence, Ariz.—Bond issue of $50,000 for electric light and water plant will be voted on March 13.

Iola, Kans.—City may purchase liquid chlorine water sterilization plant. T. R. Bartlett, City Engr.

Menominee, Mich.—City plans to install filtration plant this year. Albert Hass, City Engr.

New Brunswick, N. J.—New dam will be built, machinery purchased and stand pipe erected. Asher Atkinson, City Engr.

Ravenna, Ohio.—1,600 lin. ft. cast iron water mains. Also diversion dam and conduits. Appropriation $100,000. W. H. Linton, Director of Service.

Revere, Mass.—$20,000 appropriated for cast iron water mains. Carl G. Richmond, City Engr.

Three Rivers, Minn.—Filtration plant being considered. Geo. W. Walker, City Engr.

Tuscola, Ill.—Bond issue for municipal water works plant will be voted on March 13. Address City Council.

Virden, Ill.—Plans being prepared for water works system. Probable cost $50,000. W. A. Fuller, Consult. Engr., St. Louis, Mo.

MISCELLANEOUS.

BIDS REQUESTED.

Chicago, Ill.—March 6 until 11 a. m., for the following supplies: One 5-ton tandem roller for municipal asphalt plant, 15th Place and Ashland Ave. C. c. $100; for about 600,000 paving brick, C. c. $600; and for about 15,000 bbls. Portland cement, C. c. $1,200. W. R. Moorhouse, Commr. of Public Works.

Detroit, Mich.—March 6 until noon, for pumping apparatus for sewage treatment plant. C. c. 5 per cent. of bid. Wm. T. Dust, Commr. of Parks & Blvds.

Indianapolis, Ind.—March 6 until 10 a. m., for 100,000 gal. of road oil. C .c. $100. Chas. E. Collin, Pres. Bd. Park. Commrs.

Kokomo, Ind.—March 8 until 2 p. m., for five road graders and ten 3-way road drags. Wm. L. Benson, Aud. Howard County.

Lancaster, Pa.—March 22 until noon, for 5 horizontal 2-stage centrifugal pumps, capacity 2,100 to 3,500 gals. per min.; for 3 horizontal single stage centrifugal pumps, capacity 3,500 to 4,900 gals. per min. and 2 vacuum pumps. C. c. $500. J. H. Dathion, City Controller.

CONTEMPLATED WORK.

Belleville, Ill.—Road roller. W. C. Wolf, City Engr.

Bloomsburg, Pa.—Street sweeper. W. H. Ever, City Engr.

Bluffton, Ind.—Motor driven asphalt plant, 1,200 yards and steam heater for asphalt. John Mock, Mayor.

College View, Nebr.—One pump, one street sweeper and one street sprinkler may be purchased. H. A. Morrison, City Engr.

Crawfordsville, Ind.—Combination heater and pressure distributor. J. A. Cragwall, City Engr.

Davenport, Iowa.—One sprinkler wagon, road grader, two or three plows, shovels, etc. Allen R. Boudinot, City Engr.

DeQueen, Ark.—Road roller, crusher, dump wagons, etc., will probably be needed by Jefferson Highway Comm. in Sevier County. Address County Commrs.

Gary, Ind.—One 10-ton roller for street repair work. W. P. Cottingham, Asst. City Engr.

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Municipal Engineering

The World's Leading Municipal Publication

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123.

QUALIFICATIONS OF ENGINEERS

The governor of Pennsylvania appointed a commission of engineers some three years ago, according to instructions from the legislature, to investigate the question of the regulation of the practice of engineering. The report of the commission, just issued, has worked out the detail of the application of the principal for which this department of Municipal Engineering has argued for many years. The recommendation is that the qualifications of engineers wishing employment in subordinate positions on public work be determined by examinations and otherwise, and that eligible lists be provided as the result of such examinations, from which engineers shall be selected for public employment. Consulting engineers and experts are to have their qualifications passed upon by a state board without examination. The private practice of engineering is not to be interfered with.

The result of such a plan, often predicted by the writer, will be that the eligible lists for engineers of various branches and qualifications will be referred to for information about engineers for private employment, and the absence of a man's name from the lists will often be a deterrent to his employment, so that private practice will be regulated indirectly and without the objectionable features accompanying license laws for professional men.

MUNICIPAL BONDS

The popularity of municipal bonds continues, and it should be possible for cities to do much work on public improvements this year if they are willing to distribute the cost over a series of years by means of a bond issue. A good many of the smaller cities are expecting to do little this year because they do not issue bonds to pay for their improvements, and have done so much in the last year or two that they must stop to make up their deficits. In one or two sections of the country such cities expect to do but little on account of the increasing cost of materials and labor, but apparently this complaint is not widespread, and most cities report that they expect to do more work this year than last, a large proportion of them stating that they will raise the money by bond issues. Even in the cities where most of the improvements are made by assessments on the property, the deferred payments are carried by short-time bonds, for which the market is good, tho not as good as for regular city bonds.

One feature of advantage to cities is the preference for bonds a proportion of which are paid each year, so that the actual average term of the bond issue is only half that of the last bonds retired. This is the cheapest form for the cities, as shown in this department recently, and it really gives the best security to the bondholders, because as the improvements deteriorate thru use the indebtedness is diminished, so that the value behind the bonds bears always quite a direct relation to the amount of bonds outstanding. Usually there is quite a margin of value, especially if the improvements are of such a nature that repairs and renewals can be made readily and economically.

The larger cities and many of the smaller cities will take advantage of these conditions and promise now to increase materially their improvement work during 1916. Many cities, especially in the north and northeast, hold their city elections in March and April and leave it for the new city administrations to lay out the programs for the year's improvements, so that the tables and lists on other pages of this number are not complete as to these sections of the country.

COST DATA

Ordinary cost data are not of much value, because they are not accompanied by enough information about the special conditions which affect the particular job and so they must be taken with much caution if they are to be applied to any particular case. Good ideas can be obtained of the usual cost of doing work of a similar nature by collecting a sufficient number of reports from different jobs, but neither specific figures nor averages can be safely used exactly in any other case. Cost data do have their value, however, especially when there are given also as full details of conditions as are given in two or three of our articles this month, and it is worth while to study them carefully and to use them as the basis on which to make prices or estimates on a job where the effects of the local conditions can be compared.

West Washington Street Bridge under construction. Excavation of new river channel in foreground.

Flood Protection in Indianapolis

The early completion of the first flood protection work in Indianapolis will put that city at the head of those suffering severely from the floods of March, 1913, in time of completion. The variety of work and the ingenuity exercised in solving the numerous special problems arising make this brief article on methods and results of particular interest. The illustrations aid in giving a clear idea of what has been done.

INDIANAPOLIS seems to be the first city which was seriously affected by the floods of March, 1913, which has constructed any large proportion of its flood protection works.

The plans were made to protect, first, the large area on the west side of White River, covered with factories and small residences, on which the greatest damage was done, and which was left unprotected by the destruction of its levees. The existing laws were made use of after the legislature of 1915 failed to pass laws making the process less complicated, and the work was restricted to that which could be taken care of under the statutes.

The first two years after the flood were taken up in making surveys, plans and estimates and devising the new bills for the proposed legislation. A new and more active administration came into office with 1915 and immediately put the plans into shape for the letting of contracts, and as soon as possible passed thru the necessary legal steps to begin the work.

In brief, the flood protection works consist of a levee extending from the bluff at Riverside Park, at the north end of the flooded district, to the Belt Railway embankment on the south. This levee is protected by reinforced concrete walls wherever necessary, and with concrete riprap in other sections. A large part of it is wide enough to accommodate a boulevard with driveway 30 or 40 feet wide, two 15-foot lawns and one 5-foot sidewalk. In the region of the railroads, south of Washington street, the driveway leaves the levee and drops down behind it to pass under the tracks, with concrete walls on both sides. From Oliver avenue south to the south end of the Indianapolis Abattoir Company's land the levee follows the lines of River avenue and Drover street, which are elevated some 12 to 16 feet, and then turns back to the river bank. Where the levee passes the street railway plant north of Washington street it is reduced to the narrowest possible limits and still encroaches on the company's buildings. The boulevard leaves the levee a short distance above the plant and follows Bloomington street to Washington street. At the north end the boulevard turns west into Fourteenth street at Belmont avenue, near the Riverside Park dam.

The top of the levee is 4 feet above the flood height of 1913, and the channel lines of the river have been located so as to give a clear width of 650 feet and a depth of 29 feet below the high-water mark. Above Tenth street, at and for a considerable distance below Washington street and for the distance below Oliver avenue above described, the levee on the west side is set back from the old banks to straighten the stream and give the required width. Future work on the east side will be located back from the bank at other places so as to have the same effect there.

A law passed in 1915 provides that the district benefited by the levee shall pay one-tenth of the cost of land and construction and that the city and county shall each pay 45 per cent. The amount of work under the contracts was limited by the ability of the city to pay its share of the cost. The total cost is about $1,300,000, of which $500,000 is for property acquired and other expenses aside from construction. The assessment is distributed over about 1,400 acres and averages nearly $100 an acre on land worth, say, $1,000 to $5,000 an acre.

The Tenth street bridge, when it is replaced by a new bridge, will be lengthened and moved westward. The Michigan street bridge will ultimately be lengthened on the east end. The New York street bridge, shown in a photograph, is

New York Street Bridge over White River. A steel arch under construction. New levee is seen on left partly covered with snow. The boulevard is on top and the slope is ready to receive the concrete rip-rap as soon as the spring opens.

a new steel structure designed to fit the new channel. The Washington street arch bridge, shown in a photograph under construction, is building and has been lengthened very materially on the west end. The railroad bridges will all be lengthened on the west end. The railroads are now building their bridges over the new boulevard subway, and will shortly proceed with the reconstruction of their river bridges. The River avenue bridge will be lengthened to the east later, and the Kentucky avenue bridge will be rebuilt at some future time to fit the new channel. The Morris street bridge needs no attention until the east side of the river is improved.

The T. A. Kearns Company, Chicago, Ill., have the subcontract for the levee from Lansing street to the north end, including the boulevard connections at both ends to the streets. This contract covers the shaping of the old bank of the river and the fill for the levee and includes about 350,000 cubic yards of embankment. On the lower part of the work the shaping of the bank was done by a steam Lidgerwood dragline scraper outfit, the 70-foot boom and 1½-yard bucket traveling along the bank and dragging the excess dirt up and de-

Sloping and finishing levee between Belt Railroad and Belmont Avenue, near north end of work. Contractor Kearn's big drag line excavator at work. The original ground foundation is seen near the machine, the top of the levee at the right and the finished slope in the foreground. The excavator took material from the area at the left with which to build the levee, as well as that graded off the bank. Belt Railroad Bridge at left in background.

positing it in the levee. This work is all completed ready for the concrete surface protection, some of which is already in place. A photograph shows the laying of the floor of the protection on one section of the levee.

North of the Belt railroad, Schurmann avenue, the company operated a 100-foot boom and 4½-yard bucket, excavating the material from the new channel and depositing it in the levee at the rate of 5,000 cubic yards a day. The machine was operated by electricity. It is shown in a photograph herewith.

The earth in the embankment in the lower section was hauled various distances up to two miles. Four 9-car trains of 4-yard Western dump cars were loaded by a 70-ton Bucyrus shovel and handled 35,000 cubic yards a month.

Hickey Bros., St. Louis, Mo., had the sub-contract for building the wall placed in front of the levee at the Tenth street bridge opposite the mouth of Fall Creek, where the wash of that stream is dangerous. This wall is 950 feet long, and the power house of the Terre Haute, Indianapolis & Eastern In-

Laying concrete rip-rap below the water line at toe of levee slope, under protection of coffer dam. Michigan Street Bridge in background. This bridge will be lengthened toward the left when the east bank of the river is improved.

terurban Railway is immediately behind it. They used Blaw steel forms and electric power.

The Kuert Contracting Company, Indianapolis, Ind., subcontractors, are building the wall on the concave bend below the New York street bridge and above the Washington street bridge, most of it being in front of the power plant of the city street railroad system. This wall is founded on piles driven 19.5 feet below the bottom of the excavation for the wall and projecting 18 inches above it, there being four rows of piles 18 inches apart and 12 inches apart in the rows. The concrete base of the wall surrounds the pile tops and is from 8 to 15 feet thick, and 8 feet deep. It has pockets in its upper surface to bond it with the wall above.

The wall above this base is 31.5 feet high, 12 feet thick at the bottom and 15 inches thick just under the 3-foot coping, 9 inches deep. The top of the coping is 4 feet above high

Building a forty-foot section of concrete footing for retaining wall in front of street car power plant. Corner of car barn torn out to make room on the left. A-frame derrick handles materials and apparatus. Centrifugal pump in foreground pumps the water out of the excavation. Concrete mixer in rear of pump discharges concrete into place. Material for mixer reaches it through the chutes and bins at the right.

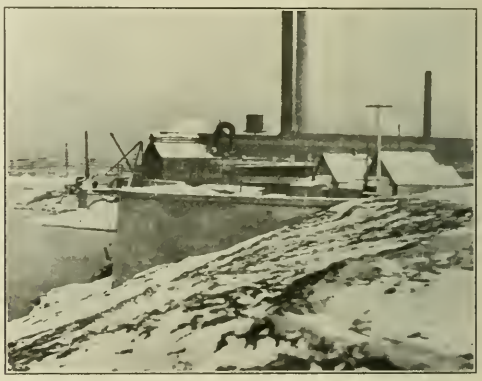
BUILDING THE CONCRETE RETAINING WALL ON THE FOOTING SHOWN IN PRECEDING PHOTOGRAPH. STEEL FRAMES FOR FORMS IN FOREGROUND, WITH COMPLETED FORMS FARTHER BACK, AND COMPLETED WALL STILL FARTHER BEYOND. NOTE THE CABLES NECESSARY TO PREVENT THE FORMS MOVING TO THE RIGHT WHEN FILLED WITH CONCRETE.

water. The batter of the wall on the river side is 1:12, and on the earth fill side is 3½:12. From the back of the foundation to a point 8 feet below the top, or about 4 feet above the former ground level, the back of the wall is waterproofed with three layers of asphalt felt put on with five moppings of asphaltic cement. There are 26,000 cubic yards of concrete in the 2,300 linear feet of this wall.

In building the wall on the pile foundation, A-frame derricks were used, mounted on a platform spanning the base, the booms being long enough to serve a 40-foot section under construction. A Vulcan steam hammer drove the 3-inch oak sheeting, which was braced with three sets of 10x10-inch wales and 12x12-inch cross-braces, one at each end and one at the center. Excavation was made with a one-yard Hayward grab bucket, a ten-inch Potts centrifugal pump driven by a straight-line Atlas engine being required to keep the water down. The outfit is shown in an accompanying photograph. Gravel excavated contained much fine sand and was used in making the concrete for the wall, the bucket delivering it direct to a screen and thence to a hopper feeding a mixer, which in turn feeds the concrete thru chute by gravity into the trench. The proportions used were 1:2½:5.

VIEW OF WALL UNDER CONSTRUCTION FROM DIRECTION OPPOSITE TO THAT OF THE PRECEDING PHOTOGRAPH. COMPLETED WALL IN FOREGROUND, SHOWING RECESS IN END TO AID IN BONDING WITH THE NEXT SECTION. CONCRETE MIXER, WITH ELEVATOR TOWER AND CHUTE BUILDING WALL, FARTHER BACK. IN BACKGROUND IS OUTFIT LAYING CONCRETE FOOTING ON WHICH THE WALL IS TO BE BUILT.

The wall above the base was built in Hydraulic Pressed Steel Company's forms, which are shown in various stages of the operation in one of the photographs. The upright and horizontal bars and clamps for holding the panel plates are clearly shown. The main vertical pieces are U-shaped, flared at the wall and with slotted keyways at the back. The panels are of wood, edged with pressed steel, and 36 inches square. Wedges driven home hold the keys in the keyholes and thus hold the clamps, which hold the panels. Wooden struts hold the forms apart until filled by the concrete, and clamps prevent spreading. Cables attached to deadmen outside held the forms, which developed a tendency to move toward the bank when filled with concrete. The sections of wall were constructed 26 feet 8 inches long and were poured in about five and one-half hours. The ribs were left in place two days before removing, but the panels were removed the next day after the concrete was poured. The forms could be moved forward and set up



UPPER END OF CONCRETE RETAINING WALL AT STREET CAR PLANT, SHOWING CURVE TO CONNECT WALL WITH LEVEE, RIVER SLOPE OF WHICH IS IN THE FOREGROUND. REVERSE CURVE IN WALL IS SHOWN IN THE CORNER OF THE COPING. WALL CONSTRUCTION IN PROGRESS IN BACKGROUND.

so that a section was poured each alternate day. The Smith mixer and Insley chute for mixing, elevating and depositing concrete, are shown in a photograph, which shows also the recess in the end of a section for bonding it with the next. Another photograph shows the curved end of the wall in front of the street railway plant where it meets the boulevard, and the reverse curve of its course. It also shows the outlets for the drainage from the power plant and the streets.

A flood in January, 1916, came when there were two openings in this wall which were not yet closed. Rapid work with teams and sand bags prevented the flood getting thru the breaks, and they will probably be out of danger before another flood arrives. One of these openings is in the vicinity of the A-frame derrick seen in the photograph, and is seen in more detail in another photograph.

The Marsch-Cleary-White Company, the general contractors for the entire work, retained for their own construction the concrete riprapping for the levees and bank slopes and all the work below the Washington street bridge.

The riprapping is done in 15-foot strips of 1:2:4 concrete, 4 inches thick, reinforced with No. 27 triangle mesh. The toe, shown in a photograph under construction, extends 6 to 10 feet below the low-water line. Concrete mixed in a ¼-yard Milwaukee mixer on the levee was put in place by steel chutes lying on the slope. In the photograph will be seen the tar paper used in shingle fashion to lead the water seeping out of the bank down to the toe of the riprap during laying and setting, where it was pumped out, thus protecting the concrete until it was fully set. The Lackawanna steel sheet piles seen in the coffer dam were driven with a 2,000-lb. drop hammer about ten feet into the gravel. About sixty feet of the coffer dam was in use at a time, and the water was let in as soon as all the slabs of the riprap had been completed.

The work of the general contractors did not differ materially from that described except that the concrete walls they built were those bounding the subways and so were not so heavy nor so deeply founded. Also, a large share of the fill was 12 to 16 feet of filling on streets well back from the river bank. Steam shovel, dump cars and dinky locomotive were used to move the dirt for the levee fills, much of which was taken from the area of the new channel just below the Washington street bridge, shown after the excavation was largely completed, in the accompanying photograph of that bridge.

At the lower end of their work a Monighan drag line excavator, traveling on rollers on a plank runway, was used for making the entire fill. It was run first along the edge of the area excavated, outside the levee lines, making the first fill for the levee. It was then run close to the top of this fill, scraping it to the proper line and slope and depositing the material farther to the rear.

WHEN THE USUAL JANUARY FLOOD CAME THIS WINTER THIS SECTION OF THE WALL WAS NOT COMPLETED. THE GAP WAS FILLED WITH SAND BAGS AND GRAVEL AND THE WATER WAS KEPT OUT, EXCEPT A LITTLE SEEPAGE, ALTHOUGH IT CAME UP ALMOST TO THE TOP OF THE PILE OF BAGS SHOWN. THIS VIEW WAS TAKEN ON THE RIVER SIDE OF THE WALL.

MUNICIPAL ELECTRIC LIGHT PLANTS IN MASSACHUSETTS

IT IS recognized by electrical engineers that steam generating plants for electrical supply are, generally speaking, more efficient and economical the larger the capacity of the station and its generating units. There is, no doubt, a limit to both, but, conversely, it is readily perceived that under a 700,000 kilowatt-hour capacity per year, the efficiency of a plant is markedly less than in larger stations.

The tendency of small electrical companies toward purchasing their electrical supply, either wholly or in part, from a large steam or water-power generating company, is being followed by municipalities, which in Massachusetts are either shutting down their isolated steam stations and procuring their whole supply from a large company, or else keeping the plant for night or auxiliary operation, according to conditions. A number of Massachusetts municipalities, also, have started municipal light plants with all purchased electrical energy, owning only their own poles and wires and acting as a distributing agency. This plan has proved very successful, obviating the responsibility for keeping up a small steam plant, and maintaining uninterrupted service, which is well-nigh impossible unless duplicate machinery is installed. It also enables towns to procure their electricity at a lower price than they would be able to produce it themselves, due to the large bulk in which the selling company produces the energy. This is especially true of towns buying from hydro-electric companies, a rate of about 2½ cents a kilowatt hour at the town's switchboard being the prevailing price paid.

The following table shows the towns purchasing energy, the company or municipality from which purchased, and the amount and price, for the year ended June 30, 1915:

Town.	*Purchased from.*	*Kw. hrs.*	*Rate.*	*Total.*
Boylston	Conn. River Trans. Co.	22,930	2½c	$573.25
Holden	Conn. River Trans. Co.	80,660	2½c	2,016.50
Sterling	Conn. River Trans. Co.	67,840	2½c	1,696.00
W. Boylston	Conn. River Trans. Co.	83,826	2½c	2,095.65
City of Worcester	Conn. Riv. Tr. Co.	103,200	1.51c	1,561.20
Paxton	Worcester El. Lt. Co.	21,140	3c	634.20
Norwood	Ed. El. Ill. Co. of Boston	1,484,000	1.92c	28,504.40
Middleton	Danvers Mun. Plant	18,843	6c	1,130.58
Belmont	Camb. Elec. Lt. Co.	482,321	3.6c	17,363.55
Georgetown	Haverhill Elec. Co.	90,450	3, 4, 5c*	3,114.65
Littleton	Lowell El. Lt. Corp.	48,590	4.77c	2,317.29

*Sliding scale.

The larger municipal plants in the State, generating from 700,000 to 13,000,000 kilowatt hours a year, made an excellent showing, the costs comparing favorably with those by company plants of corresponding size and output.

STREET LIGHTING IN DETROIT

Detroit made one of the early successes in municipal street lighting, and the plant was the subject of much acrimonious discussion until the truth of the matter was fully demonstrated. This brief history of the plant and fuller story of the last year's operations shows the reasons for what has happened. We are indebted to Frank Mistersky, superintendent of the plant, for the data from the forthcoming annual report.

DETROIT was one of the first cities to adopt the electric arc lamp for street lighting. The first contract was made in 1883 for 22 arc lamps, at 50 cents per lamp per night, operated on a moonlight schedule. The next year, in 1884, a contract was made for 300 arc lamps, on an all-night schedule. The contract price was $95,000 for the year. Following contracts somewhat reduced the rate, but the lowest was $132.41 for each lamp for the year. This was found to be higher than paid in many other cities. For this reason, and because the service was exceedingly unsatisfactory, the citizens of Detroit decided to build a municipal plant. The first lamps operated from the public lighting plant were put in service April, 1895. The entire lighting of the city by the municipal plant began October, 1895.

The cost per lamp, for operation and maintenance, not including fixed charges, as interest, depreciation, etc., for the year ending June 30, 1896, was $68.52. The same cost for the year ending June 30, 1914, was $25.21. The greater part of this reduction has been made possible by the substitution of modern and more efficient apparatus for the equipment originally installed.

The plant was built for a capacity of 2,000 arc lamps. Five marine type engines belted to twenty 50-kw. arc dynamos and three 57½-kw. direct-connected arc dynamos furnished the power for this purpose. This equipment practically filled the entire available floor space in the engine room. Today, with only an extension of about sixteen feet to the engine room, the generating capacity consists of two 600-kw. units, two 2,000-kw. units and one 6,250-kw. unit.

The two 600-kw. generators are connected to reciprocating engines; the others are connected to steam turbines. There are 7,376 arc lamps in service at present and about fifteen hundred more will be added during the year. The output for last year was 15,677,255 kw. hr.

In the boiler room, the old 300-hp. boilers with hand fired furnaces are gradually being replaced by larger boilers equipped with modern stokers. Two new boilers will be purchased this year. A coal conveyor with overhead bunker has also been in operation for about two years. These improvements can be checked from one year to another in the consumption of coal per unit output. In 1898 the coal per kw. hr. was 5.23 lbs.; last year's records show 3.12 lbs. of coal per kw. hr., a reduction of more than 34 per cent. During this time the grade of coal used has been approximately the same. This year's contract for West Virginia nut, pea and slack, on a contract guarantee of 14,113 B.t.u., is on the basis of $2.25 per ton, delivered on the siding of the public lighting plant. All coal is purchased on a penalty or bonus basis.

About as good a showing has been made in reductions of cost in other directions. The trimming of the Brush arc lamps, which in 1898 was $16.15 per lamp per year, for carbons, globes and labor, was reduced to $3.98 per lamp when series alternating current lamps replaced the Brush lamps; and was again reduced to an average of about $2.06 per lamp per year for the 4-ampere luminous lamps, which are gradually replacing the series alternating lamps, of which there are only 2,337 now in operation in the outlying districts of the city.

The plant is favorably located at the river bank about halfway between the easterly and westerly limits of the city. Coal and carload lots of supplies are delivered directly into the yard of the plant over a spur track built for that purpose.

All electrical energy is generated at 2,300 volts, two-phase. For outlying districts this voltage is raised to 5,500 and 6,600 volts and distributed to five sub-stations—about three and one-half miles from the main station—from which the several arc circuits for the respective districts are carried.

In addition to the arc lighting, service is given to more than 200 public buildings, including school houses, fire department engine houses, police stations, libraries, public parks, etc., etc. This includes service for a connected load of 1,427-hp. in motors and more than thirty thousand incandescent lamps.

Wages paid to all help are about the same as paid by Detroit private corporations for the same service. The working day is eight hours. Every year ten days' vacation with pay is given to each employe. In case of injury while on duty, all expenses for medical attendance are paid by the commission, and full pay is given to the injured employe during the time that he is incapacitated for work. That conditions are agreeable to the workmen is proved by the fact that in every department there are many employes who helped in the construction and first year's operation of the plant.

If the municipal plant of Detroit has proved a success, it is due to the caliber of the men who have served as Public Lighting Commissioners. Some of Detroit's most eminent citizens have considered it an honor to be able to give of their valuable time and ability in the service of the city.

The following figures are based on operation of plant for year ending June 30, 1915:

Total kw. hr. output at the switchboard for year ending June 30, 1915	17,327,785
For year ending June 30, 1914	15,677,255
Increase in kilowatt hours	1,650,530
Increase, per cent	10.53
Expended for operation and maintenance for year ending June 30, 1915	$235,836.14
For year ending June 30, 1914	227,231.25
Increase	$ 8,504.89
Increase, per cent	3.74
Cash cost of operation and maintenance for year ending June 30, 1915	$235,836.14
Less credit:	
Sale of old material	$3,599.12
Rentals	2,376.19
Incandescent lighting of County Building, etc.	7,294.01
Superintendence, use of tools, etc., for foreign work	690.58
	13,959.90
Net cash cost of operation and maintenance	$221,876.24

The total output in kw. hrs. for year ending June 30, 1915, was divided as follows:

For arc lighting	14,198,043
For incandescent lighting and power service	3,129,742

The net amount expended for operation and maintenance proportioned between the arc and incandescent lighting, according to the output of each, is as follows:

Arc lighting	$181,800.99
Incandescent lighting and power service	40,075.25
Average number of arc lamps operated during year	7,487
Net cash cost per arc lamp, year ending June 30, 1915	24.28
Net cash cost per arc lamp, year ending June 30, 1914	25.21
Net cash cost per kw. hr., year ending June 30, 1915	0.0128
Net cash cost per kw. hr., year ending June 30, 1914	0.0134
Total number arc lamps in operation June 30, 1915	8,193
Total number arc lamps in operation June 30, 1914	7,343
Increase in number of arc lamps for the year	850

According to the Municipal Manual, compiled by the city clerk, the population of Detroit for 1915 was 673,498. With 8,193 arc lamps, this would give one arc lamp for every 90 inhabitants. The total length of streets is given at 757.14 miles. This would give an average of 9.88 arc lamps per mile of street. For the year 1914, with 710 miles of streets, the ratio was 9.44 arc lamps per mile of street.

From the foregoing, it will be seen that the cash cost per arc lamp for the year has been reduced 93 cents per lamp. This reduction has not been at the expense of the plant maintenance, as the report shows an expenditure of $2,397.82 for maintenance of buildings; $7,541.22 for maintenance of steam plant; $3,860.33 for maintenance of electric plant; $4,131.05 for maintenance of tools and machinery; $6,868.32 for maintenance of arc lamps and switches; $29,138.08 for maintenance of overhead lines and underground cables, etc., etc.

The result of such expenditures is shown in the record of lamp-outs. With a total of 29,207,855 lamp hours for the year, the total "outage" was reported at 30,649 lamp hours, or about .1 of 1 per cent.

During the year wages in all departments have been increased sufficiently to compare favorably with those paid by private corporations for similar work. This has enabled the commission to retain the services of competent employes. As long as the commission can pay its employes in accordance with their ability, and the value of their services to the public lighting plant, or to a private corporation, the Detroit public lighting plant can be in the front rank of municipal enterprises. But as soon as this ceases to be true, the Detroit public lighting plant will fall in line with hundreds of other municipal plants, the success of which is rather doubtful.

As it is, a number of employes leave the service of the public lighting plant annually, for the reason that private corporations will pay what a man is worth, whereas at least some of the salaries paid by the commission are fixed and cannot be changed, and those that are not fixed are limited, for at least the balance of the fiscal year, by the appropriation received for that year.

The entire public lighting system was in better shape at the end of the year than for some time. The additions built to three sub-stations made it possible to remove the hazard due to the limited space in which it was necessary to install required apparatus.

A "Safety First" committee, made up of heads of all departments, meets monthly to discuss possible hazards and to devise means of eliminating the same. A pulmotor was purchased to give prompt aid to employes unfortunate enough to require such assistance. It is also available to the general public upon call. An automobile and attendant is always available for the purpose.

Other improvements worthy of mention are the following:

A new 5,000-kw. turbine generator is now in operation. This, with the two new boilers now being erected, will make a considerable reduction in the station cost of the power output.

The construction of conduits in the Boulevard, in Jefferson avenue, Grand River avenue, Boston boulevard and Fort street West made it possible to illuminate these streets properly, and will ultimately permit the removal of objectionable overhead lines. Nothing in this line is more urgent than the construction of conduits and the installation of underground cables to replace the 5,500-volt sub-station feeders now carried overhead thru the streets and alleys of the city, in many instances within a very limited distance from high apartment buildings and buildings used for industrial purposes. This is an urgent "Safety First" measure.

The books show the present investment in the public lighting plant to be $2,598,467.04. But, after twenty years' operation of the plant, it would seem to be a good business proposition to get an inventory of the entire system, to determine what has been the actual cost of the street lighting. Since 1908 the commission has reported cash expenditures only, making no attempt to show depreciation charges, because no precise information is available.

The personnel of the department for inspection of interior wiring consists of one chief inspector, sixteen inspectors, four clerks and one telephone operator.

The amount of the fees collected was $30,103.56. The expense of the department totalled $27,394.77. This included the purchase of three Ford automobiles, one for the chief inspector and two for inspectors on special work. The other inspectors use bicycles and motorcycles.

The total number of inspections made during the year was 73,944. The total number of defects found by the inspectors during the year ending June 30, 1915, was 14,694. The total number of certificates issued was 27,221.

During the year 2,745 inspections were made of old wiring installations; 484 of these were in industrial buildings, and 2,261 in other types of buildings. Of the 484 industrial buildings, 56 only were approved; in the others changes in the wiring were recommended. In other buildings changes were asked for in 820. Fees collected for the reinspection of wiring in 2,745 installations totalled $393.25 only.

Twelve complaints were filed in the Recorder's Court, on account of electrical work done without permit. In most of these cases sentence was suspended. One delinquent was instructed by the court that he must do no more electrical contracting in the city of Detroit.

In the inspection department for overhead lines it is reported that the two inspectors found 2,641 defects in overhead wires. Of these, 1,293 defects have been corrected, and the others will be remedied as soon as possible.

COMPARATIVE KILOWATT HOUR OUTPUT.

The following table comprises a listing of comparative kilowatt-hour output for twelve months prior to June 30, 1915:

	Arc Lighting	Incandescent Light and Power	Total Output
July	893,875	171,930	1,065,805
August	1,000,583	172,957	1,173,540
September	1,100,929	196,611	1,303,540
October	1,316,542	264,788	1,581,330
November	1,395,504	300,306	1,695,810
December	1,507,163	346,157	1,853,320
January	1,485,837	361,173	1,847,010
February	1,258,298	326,802	1,585,100
March	1,243,805	311,545	1,555,310
April	1,078,605	246,545	1,325,150
May	981,301	241,879	1,223,180
June	929,601	189,089	1,118,690
Totals	14,198,043	3,129,742	17,327,785

LAMPS AND HOURS OPERATED.

	Av. No. Lamps	Total Lamp Hrs. Scheduled	Total Outage Time Hrs. Min.
July	7,356	1,785,731	2,386:25
August	7,373	2,054,305	2,399:35
September	7,375	2,288,206	1,354:55
October	7,378	2,704,505	3,520:40
November	7,382	2,910,110	4,953:55
December	7,401	3,184,491	3,975:25
January	7,428	3,116,910	2,724:20
February	7,451	2,603,300	2,623:05
March	7,529	2,571,547	2,140:30
April	7,589	2,190,260	778:45
May	7,607	1,975,727	1,913:—
June	7,972	1,822,763	1,863:55
Av. and totals	7,487	29,207,855	30,649.50

ARRANGEMENTS OF SERIES ARC LAMPS.

The lighting of the city is done exclusively by means of arc lamps. The lights are placed on ornamental posts, mast arms, towers and cranes as the conditions demand. The 8,193 lamps in operation on June 30, 1915, were distributed in 7,924 locations as follows:

250 Cranes	250 Lamps
13 Center Suspensions	13 Lamps
5,277 Mast Arms	5,277 Lamps
2,157 Single Ornamental Posts	2,157 Lamps
137 Double Ornamental Posts	274 Lamps
9 Single Trolley Poles	9 Lamps
25 Double Trolley Poles	50 Lamps
28 Three-light Towers	84 Lamps
14 Four-light Towers	56 Lamps
1 Water Works Tower	4 Lamps
On Base of Towers	6 Lamps
In Buildings	13 Lamps
Total	8,193 Lamps

COST OF OPERATING PLANT FISCAL YEAR ENDING JUNE 30, 1915.

Maintenance:

	Wages	Stores	Total	Pr. Kw. Hr.
Bldgs., track, dock, etc.	$ 1,044.03	$ 1,353.79	$ 2,397.82	
Steam plant	4,473.36	3,067.86	7,541.22	
Electric plant	2,979.05	881.28	3,860.33	
Misc. tools and mach.	1,140.99	2,990.06	4,131.05	
Conduits	674.80	521.50	1,196.30	
Towers and lamp posts.	1,302.00	485.06	1,787.06	
Arc lamps and switches	4,895.90	1,972.42	6,868.32	
Lines and cables	19,664.33	9,473.75	29,138.08	
Total maintenance	$36,174.46	$20,745.72	$56,920.18	.00329
Executive:				
Salary Sec. & City Elec.	$ 8,000.00		$ 8,000.00	
Ptg. and stationery		$ 848.88	$ 848.88	
Store room	1,187.21	208.52	1,395.73	
Office expense	7,828.21	867.07	8,695.28	
Supt. & draughting	6,693.40	187.93	6,881.33	
Total executive	$26,708.82	$ 2,112.40	$28,821.22	.00166
Station.				
Oils		$ 481.28	$ 481.28	.00003
Waste		30.97	30.97	.00000
Coal		64,375.32	64,375.32	.00372
Misc. supplies		1,133.08	1,433.08	.00008
Wages	$38,523.88		38,523.88	.00222
Total station	$38,523.88	$66,320.65	$104,844.53	.00605
Lighting:				
Trim. & patroling	$18,831.10	$ 232.00	$19,063.10	
Electrodes		8,618.15	8,618.15	
Rectifier tubes		1,721.00	1,721.00	
Incan. lamp renewals		4,801.61	4,801.61	
Incan. lighting exp.	845.41	380.31	1,225.72	
Globes		2,471.47	2,471.47	
Misc. supplies		49.75	49.75	
Belle Isle Park	798.15	135.70	933.85	
Palmer Park	68.86	10.34	79.20	
Total lighting	$20,543.52	$18,420.33	$38,963.85	.00225
Shop supplies		$ 40.65	$ 40.65	.00000
Surgeon and hospital	$1,100.38	1,029.72	2,130.10	.00012
Relief fund	4,115.61		4,115.61	.00024
Total operat'g cost	$127,166.67	$108,669.47	$235,386.14	.01361
12 mo. to June 30, '14	$120,762.31	$106,568.94	$227,331.25	.01450
12 mo. to June 30, '13	108,036.66	90,479.77	198,516.43	.01440
12 mo. to June 30, '12	102,080.00	85,732.96	187,813.05	.01538
12 mo. to June 30, '11	99,396.37	80,171.52	179,567.89	.01686

The work of trimming arc lamps is entrusted to the care of eleven men. There were 2,147 series alternating current enclosed lamps, 5,561 4-ampere and 485 6.6-ampere General Electric Company's luminous arc lamps in operation June 30, 1915. There are 129 circuits, averaging 60 lamps each. The total number of lamps of each kind and their methods of support are shown in the following table:

Boulevard ornamental posts (single)	485
Single ornamental posts	1,672
Double ornamental posts	137
P. L. C. mast arms	5,277
Center suspensions	13
Cranes	250
Single trolleys	9
Double trolleys	25
Towers	43
Tower lamps	150
Buildings	13
Luminous arc lamps, 6.6-amp	485
Luminous arc lamps, 4-amp	5,561
A. C. enclosed lamps	2,147

Following is a listing of the disbursements on investment accounts of the department for the period intervening from April 4, 1893, to June 30, 1915:

PUBLIC LIGHTING SYSTEM INVESTMENT.

Investment Accounts:

Buildings and wharf	$ 318,025.97
Steam plant	459,018.95
Electric plant, arc	365,197.47
Electric plant, incandescent	66,259.23
Misc. tools and machinery	30,993.01
Conduits	541,517.82
Towers and lamp posts	237,217.55
Arc lamps and switches	258,419.18
Overhead lines	670,468.52
Cables	325,938.49
Belle Isle Plant	45,768.98
Palmer Park	10,444.44
Real estate	85,460.83
Railway track and scales	11,628.31
Total amount expended for investment	$3,426,358.75

The Municipal Supply Department—II.

STORE KEEPER AND STOREHOUSE

By Hugh M. Foster, New York City.

This is the second of a series of articles on the handling of supplies for municipal departments, and it is devoted to the most important single division of the department, the storehouse. Much money can be saved by intelligent, careful and honest administration of the stores, in purchase and in filling of requisitions. And much can be lost by inefficient, careless handling of requisitions and purchases of materials to fill them. Often the opportunities for dishonesty, particularly in taking "commissions" on purchases, are many. The storekeeper must therefore know his business and attend to it, must have good judgment, and must be absolutely honest.

THE greater opportunity for economy is in the stores division, rather than in the purchase division of the municipal supply department. The purchasing agent's achievement is in the reduction of prices, but the storekeeper's achievement is in the reduction of quantities, the control of distribution, the supervision of consumption and the basic, systematic structure of the whole function of furnishing supplies. Another great value of the storekeeper is his ability to act as a wholesome check upon the purchasing agent. For this reason he should be independent of the purchasing agent. For the system to be effective at its best, these two officials should work in harmony, but by keeping in close touch by daily communication each should furnish the other with all suitable information and act as a check on the other by means of such information, rather than in the spirit of carping criticism.

In establishing a general storehouse, the first and most important consideration is its location, which should be central, not only from a geographical point of view, but also from the point of view of facilities for receiving and issuing supplies.

The storehouse should be placed so as to afford the shortest route to the majority of subsidiary storehouses or minor receiving points for the consumption of supplies; also it should be equipped with all modern facilities for receiving and issuing supplies. If possible, it should be so located as to be reached both by rail and by water, with proper railroad sidings for unloading carload lots. Connection should be made with city trolley lines, so that a supply trolley car may be sent from store to various municipal receiving points. Such a trolley supply car should be similar to the trolley car used by express companies for suburban deliveries.

In a general storehouse, systematic arrangement in handling facilities—bins, shelves, racks, scales, tracks, carts, crates, trucks, etc.—should be carried to the most scientific development. The same systematic design should prevail in the facilities for issuing supplies, in the equipment of automobile trucks, wagons, carts, and in the packing and shipping room.

The whole general storehouse should be subdivided into sections, with a section foreman in charge of each. In that section should be only one classification of supplies. The supplies most frequently used and in small quantities to be issued over the counter to workmen or shop foremen should be nearest the entrance for such workmen.

The care of supplies in stores is quite as important, because many kinds of supplies will deteriorate thru improper care, such as lime, cement, paints, flour and feeds.

The tool room is one of the most important parts of the storehouse. In it should be a properly designed place for every known tool. Each tool should be marked with a number corresponding to the place where it belongs. Tools carried in stock, and which are required for a particular job but not longer, may be loaned to workmen on loan requisitions and charged to the workmen during the time of use. Expensive tools and tools subject to temporary use may be made more durable by being under the charge of the foreman of the tool shop and kept in proper repair. All tools, and, in fact, all city property susceptible of such identification should be conspicuously branded or marked to prevent theft, and no new tool should be issued to a workman except upon return of the old tool for the scrap heap.

One great advantage in a general storehouse over many storehouses scattered thruout various branches of the municipal government is that by concentration in one place, surplus stock can be enormously reduced. In the decentralized system, while one institution is in urgent need of a given article of supply, some other institution may be carrying an old surplus of that same article, and the institution in actual need forces the emergency purchase at great disadvantage. By centralizing in one general storehouse, the minimum of stock would be in any institution, and surplus would be forwarded as needed from all subsidiary branches. Therefore the need of any institution could be satisfied at once from stock.

The general storekeeper should have supervisory control of all requisitions, and by complete statistical records should recognize at once any unusual requisitions, and upon request should be furnished with further information explaining the reasons for any such unusual request, either as to article or quantity. A daily balance account should be kept showing the exact state of business at the end of each day, and this should be forwarded in duplicate to the purchasing agent and to the comptroller.

Next to the general storehouse should be placed a yard for castings and heavy metals, pipe racks and lumber sheds. The closer the general repair shops are to the general storehouse, the greater the service the latter can render the former. It is another evidence of waste of the decentralized condition for the department of street cleaning, the fire department, department of docks and ferries and any other department which carries on great repairs and construction, to have their repair shops separate. These should all be centralized in one great repair plant situated next to the general storehouse.

The importance of complete statistics to the storekeeper is as great as, if not greater than, to the purchasing agent. Correct storekeeping aids purchasing, distribution, cost accounting and efficiency of management.

In the general storehouse stock cards should be kept for every article of supplies, which should show their receipt and issue, with their dates. The difference between the issues and receipts shows at any time the amount on hand. Such stock cards may be kept on the bins, shelves or other receptacles for the supplies, or may be kept in the office of the general

foreman of the store in a card-index cabinet. Such cards should bear a location number similar to the library system, showing the location of every article in stock.

Supplies should be furnished only on written requisitions from those authorized to make them, and bearing all proper certifications.

Each section foreman knows his own stock, and by watching carefully the consumption of his stock, he informs the general storekeeper in anticipation of a lack, and so prevents running short. In each section should be kept on hand a "want book," in which the section foreman should record any article called for which is not in stock, or which is not intended to be carried. This record should be reported monthly to the general storekeeper, and if the number of such calls warrants it, the articles should be carried in stock.

To every requisition made by the general store keeper on the purchasing agent should be attached a perforated stub for notice of delivery. On this stub should be indicated the actual date when the supplies are needed in the storehouse, and the date of promised delivery should be filled in by the vendor, so that the storekeeper may be informed of date of delivery and prepare for the reception. By such a system and a proper method of tracing delivery and following up notices, the purchasing agent is kept informed of dealers who are delinquent in delivery.

Under the decentralized system of handling supplies, one of the greatest abuses is the enormous proportion of purchases made on open market orders; that is, without due contracts and often without fair competitive base. The total purchases by the open market method for a given year may approximate 25 per cent. or 30 per cent. of the whole expenditures for supplies to the city, whereas, in a well regulated corporation, such purchases do not amount to more than 3 per cent. to 5 per cent. As a matter of fact, such open market purchases should be confined only to actual emergencies, and even in such cases, the emergency should be certified to by the head of the department, explaining fully the causes which lead to such a condition. An emergency purchase is always at a disadvantage. Another phase making for greater efficiency in scientific management of stores is the opportunity offered for correct cost accounting.

Supplies issued from the general storehouse to branch storehouses or to institutions for consumption should be charged against the consumer at a price averaged from the price obtained by purchase covering a period since the receipt of the first purchase of the article. That is, if a given article is purchased in one month at a given price, and another month at a different price, and the articles are such they they cannot be kept separate, but must be mixed in one receptacle, they should be charged at the average of these two prices.

Besides the perpetual inventory maintained in a storehouse by stock cards, the comptroller should make an annual inventory based upon actual physical count as a check upon the storekeeper.

A central storehouse should be a clearing house for the receipt and distribution of supplies, and it should never be considered as a repository for supplies. The ideal theory of a storehouse is that of a water reservoir which sends out the same amount of water which it receives. The test of a storekeeper and his ability to manage a storehouse is determined by the approximation of issues to receipts. The ideal condition is equality of different issues and receipts. Of course, this is an ideal and is never actually attained. If his receipts greatly exceed his issues, his stock is growing, and the storekeeper is merely piling up surplus. If his issues greatly exceed his receipts, his stock is running short, and he is rapidly approaching the catastrophe of being unable to supply needs.

A separate division of the general storehouse should be a cold storage plant for the storage of perishable supplies, such as meat, fresh fruits and vegetables, butter, eggs, etc. The advantage in having cold storage facilities for such supplies, rather than having them bought and delivered daily or weekly, is that they can be bought in larger quantities and consequently at lower prices, and also they can be bought at the season when the market is low. This is particularly true in the case of butter and eggs.

The same general principle as the purchasing and storing of perishable goods applies to coal. That is, the market for coal is low in the late spring and early summer. Therefore, by buying in the largest quantities at that time of the year the best prices can be obtained. For that reason it would be to the advantage of the city to maintain adequate coal pockets.

Adequate forage sheds should be maintained with a capacity of a year's supply, for the method of purchasing, delivering and using forage in driblets and diffused over many delivery points extended thruout an enormous territory, is an economic waste.

BIG CHICAGO BRIDGE COMPLETED

The Jackson boulevard bridge, city of Chicago, has been completed by the sanitary district of Chicago under the act of the General Assembly of the State of Illinois empowering the district to remove obstructions from the Chicago river. The rebuilding of this bridge has been a subject of controversy for many years, the sanitary district trustees desiring a span that would cause no obstruction in the river, while the railroad companies owning property on the west side of the river had refused to permit any encroachment on such property on the ground that it would make impracticable the proposed new Union Terminal Station.

It was the intention of the sanitary district to make a record for minimum interruption of traffic across the river due to construction of the new bridge, and it was specified that the west abutment should be partially built under the old swing bridge while the latter remained in service, that the old bridge should not be removed prior to March 15, 1914, and that the new bridge should be ready for traffic on April 1, 1915.

Work was commenced in February, 1914, and the old bridge continued in service until May 11, 1914. Due to labor strikes and to serious and unforeseen difficulties encountered in constructing the abutments, the work was prolonged considerably beyond the time specified in the contract.

The bridge is 274 ft. long from end to end and consists of two movable leaves, one 123 and the other 128 ft. long. The roadway on the bridge is 37 ft. wide in the clear between curbs and is paved with creosoted wood blocks resting upon a solid floor of 6-in. creosoted planks. The two sidewalks have a width of 13 ft. each from curb to railing, and the entire bridge is 64 ft. wide, out and out, as wide as can be made to open between the abutting buildings.

MUNICIPAL SEWER CONSTRUCTION

IN MOOSE JAW, SASKATCHEWAN

War conditions brought about the circumstances described in this article, which shows what can be done with comparatively inefficient and inexperienced labor under the worst of weather conditions, when "needs must." The financial results are remarkable when all the conditions are considered.

THE city of Moose Jaw, Saskatchewan, is so located that all its sewage must be pumped into the disposal works. It has, therefore, been necessary to adopt the separate system of sewerage. A system of sewers for house drainage was constructed some years ago and has been extended as the growth of the city demanded.

Until recently the surface water drainage of the city was taken care of by Thunder Creek and Moose Jaw Creek, which unite near the Eleventh Avenue subway, with help from an occasional storm sewer, the first of which was constructed in 1906. But as the city grew, very rapidly, and streets were graded, many small natural watercourses, thru which storm water had reached the streams over the surface, were obliterated and serious flooding of certain streets and the abutting property occurred each spring. To improve this state of affairs, plans were made for systems of storm sewers in four districts. One of these sewers, recently constructed, is 7,744 feet long and varies in diameter from 30 inches to 12 inches. Bids for the sewer showed the following comparative prices for the larger sizes:

	Vitrified Tile	Segment Block	Concrete
24-inch	$1.75	$1.80	$1.75
30-inch	3.32	2.30	2.60

Tile pipe from the Redwing Sewer Pipe Co. and the Alberta Clay Products Co., Medicine Hat, were used for the 24-inch size, and segment block from the American Sewer Pipe Co., Akron, Ohio, were used for the 30-inch.

The contract was let just before the war began, and on account of the war it was cancelled. Later, when the problem of the unemployed during the winter season become acute, the city council decided to construct the sewer by day labor. The work began in December and was completed in March. Winters in Moose Jaw are severe, the temperature being below freezing at all times, and falling as low as 40 degrees below zero. To relieve as many as possible, the men in the gangs were changed each week, and any one man averaged about one week's employment in three. The number of men employed averaged 57 each day. The cost data for this article are from a paper in *The Canadian Engineer*, by George D. Mackie, the city engineer-commissioner, who expresses the opinion that the efficiency of the labor was not 50 per cent. that of a regular laborer in the same line, as the men employed were from all trades and employments, unfitted for and unaccustomed to such work.

Notwithstanding the inefficient labor and the extra cost of doing work in the winter, the total cost of the work, $26,795.63, compared very favorably with the contract price computed from the bids given above, $25,008.89. The laying of the segment blocks, for example, can be done under ordinary conditions for about one cent per foot for each inch diameter of sewer, but in this case the blocks were heated and bedded in hot moist sand and covered with the same until the cement in the joints could set. The men tending fires, and the fuel, were extra, and there was some extra work, if not extra pay, for the handling of the sand and blocks into and out of the heat. The cost to the city included all clerical work, supervision, insurance of men, rental of tools and the maintenance of the sewer for six months after completion.

The following tables show the cost of building the sewer and of building manholes and catch-basins. The statements of depth to which frost extended in the trenches are of interest, as indicating the extra cost of excavation. They also explain the tunneling shown in the accompanying photograph and the slight bracing necessary, especially in the upper part of the trenches.

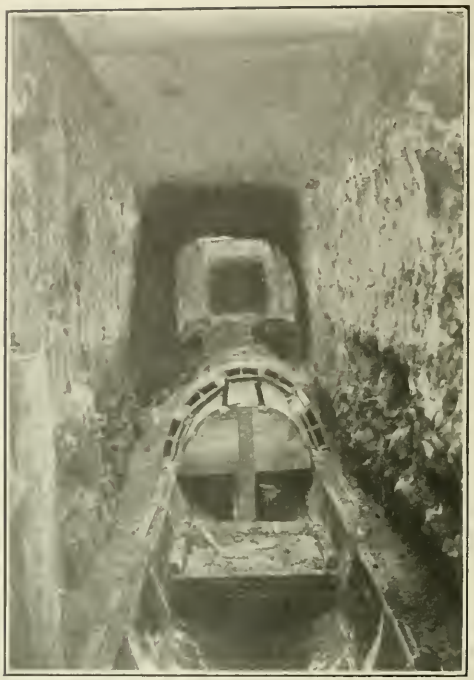
COST OF STORM SEWERS PER FOOT.

Size of pipe	12-in.	15-in.	18-in.	20-in.	24-in.	30-in.
Material	Tile.	Tile.	Tile.	Tile.	Tile.	Seg. Block.
Length of section	1581 ft.	1509 ft.	1134 ft.	2086 ft.	635 ft.	797 ft.
Average depth	6.6 ft.	7.00 ft.	9.5 ft.	7.25 ft.	11.0 ft.	12.5 ft.
Nature of soil	Gray clay, 6 ft. frost.	Clay and gravel, 7 ft. frost.	Gray clay 5 ft. frost.	Clay and gravel, 3 ft. frost.	Clay and gumbo, 5 ft. frost.	Gumbo, 4 ft. frost.
Yardage per lin. ft.	.65	.70	.90	.80	1.22	1.85
Cost per lin. ft. excavation	$ .65	$1.01	$1.03	$ .49	$1.34	$1.75
Backfill	$ .05	$ .07	$ .13	$ .13	$ .30	$ .40
Teaming, watching, timekeeping, etc.	$ .14	$ .16	$ .16	$ .22	$ .22	$ .70
Pipe laying	$ .06	$ .06	$ .09	$ .12	$ .13	$ .52
Material	$ .60	$ .93	$1.19	$1.41	$2.01	$2.89
Total cost	$1.50	$2.23	$2.60	$2.37	$4.00	$6.26
Estimated cost	$2.00	$2.25	$3.00	$3.00	$4.00	$5.00

COST OF MANHOLES AND CATCH BASINS.

	No.	Vertical Feet	Total Cost	Unit Cost	Cost per Vertical Foot With Covers	Cost per Vertical Foot Without Covers
Manholes—Concrete	25	206	$1,710.37	$68.41	$8.30	$4.45
Brick	4	48	395.70	98.92	8.24	5.74
Catch Basins—Concrete	44	249	1,425.32	32.40	5.73	3.69

Materials—Sand, $1.80; gravel, $2.30; crushed stone, $3.30 pere cubic yard. Cement, 75 cents per bag F. O. B. the job. Labor, 25 cents per hour.



There were also 1,219 lin. ft. of catch basin connections, connecting the 44 concrete catch basins with manholes, there being 4 basins at each street intersection. These lines averaged 4.5 feet depth and were frozen to the bottom of the trench. Two connections at each street intersection were tunneled under the street railway track. The cost, 84.5 cents per lin. ft., for these catch basin connections was therefore somewhat high.

The catch basins had 9-inch concrete walls and 2.5 ft. inside diameter, of 1:3:5 proportions of concrete materials and plastered with an inch of 1:1 mortar. Concrete manholes were of like construction and of 3.5 ft. inside diameter. Four manholes of irregular design, because of their location and obstructions encountered, were built of brick. Costs of all are given in the last table above.

BUILDING A VITRIFIED SEGMENT BLOCK STORM SEWER IN MOOSE JAW BY DAY LABOR IN SEVERE WINTER WEATHER. DEPTH OF FROST MAKES TRENCHES SOLID ENOUGH TO REQUIRE LITTLE OR NO TIMBERING AND ALMOST TO REQUIRE TUNNELING UNDER THE FROZEN DEPTH. WARM BLOCKS, WARM SAND, WARM WATER AND PROMPT BACK FILLING MADE THE WORK POSSIBLE.

WATER METER RATES RECOMMENDED BY NEW ENGLAND WATER WORKS ASSOCIATION

A committee of the New England Water Works Association, named to consider problems pertaining to water rates, has rendered its report, with recommendations and a standard form for rates. It is suggested that for domestic service with ⅝-inch meter, the ordinary service charge may properly be about $3 per annum where service and meter are paid for by the taker; $4 where the meter is furnished by the works, and $5 or $6 where both meter and service pipe are paid for by the works, the lower figure being used where the average cost of the service pipe is under $15 and the higher rate where it is over $15. These charges are, however, subject to modification due to local conditions.

It is desirable, the committee says, that the price per 1,000 gallons or per 100 cubic feet be an even number of cents, without fractions, and that the domestic rate and manufacturing rate be first fixed. The latter should seldom be less than half the former, and for the intermediate rate the price should be to the nearest cent midway between the average and the mean proportional of the two. The minimum charges for services with meters larger than ⅝-inch may be fixed at larger sums, computed according to methods indicated in a previous report.

A flat rate for all quantities may be made by fixing the same price for water for domestic purposes and for manufacturing purposes. The committee recommends that where the same works supply water in different services, under conditions imposing much greater relative expense in one or more services as compared with others, because of high-service pumping, etc., it is fair to add the extra cost to customers supplied in those districts, according to ascertained costs.

It is recommended that the statistics of sales by meter be classified on the basis of 300,000 gallons or less per year, as constituting the domestic rate, 300,000 to 3,000,000 gallons the intermediate rate, and over 3,000,000 gallons the manufacturing rate. For quantities in cubic feet, the first 10,000 cubic feet quarterly would constitute the domestic rate, 10,000-100,000 cubic feet the intermediate, and over 100,000 cubic feet the manufacturers' rate. Monthly bills would be reckoned on the basis of the first 3,300 cubic feet as the domestic rate, 3,300-33,000 the intermediate, and over 33,000 cubic feet the manufacturers' rate.

Rates should be fixed so as to produce the required revenue, and according to local conditions.

Gravel as an Aggregate for Concrete

By Prof. H. H. Schofield, Purdue University,
and Charles C. Brown, Consulting Engineer.

Specifications for gravel have never been written, that material being treated as tho it were broken stone, whereas it is a very different material and requires very different treatment to obtain the best results. This study of the data regarding gravel and sand for concrete demonstrates the need for further tests and for the development of a real gravel specification.

THE consumption of gravel as an aggregate for concrete has been estimated to be nearly 50 per cent. of all the aggregates used in the nation. In states, such as Indiana, having great natural deposits of good gravel, the consumption is much larger in proportion.

Hitherto there has been no rational or complete specification for gravel as an aggregate. The specifications which are in use oftentimes permit the use of an inferior material, or what is more important and common, exclude gravels which with proper treatment will make excellent concrete. This latter fact often causes a waste of good material in some localities. In the opinion of the writers of this paper, a specification should be rigid enough in its requirements to insure good and uniform concrete, and elastic enough to allow the use of as much of the natural deposits as possible.

No doubt one great reason for this neglect of the specification for gravel is to be found in the fact that there is so much variation in that material, the layers in the same pit or stream varying among themselves, and the gravels in one district being quite different from those in another; and at the same time practically satisfactory concrete is obtained from these varying gravels without a standard specification, dependence being placed on inspection, subject to individual opinion and experience. This results in the vast waste of good material just referred to, and in a somewhat lower average of concrete produced therefrom.

The relation of the sand and gravel in concrete is so intimate that it is impossible to consider the gravel without at the same time considering the sand, and it is by no means certain that the usual line of division between sand and gravel is the proper line, or that the dividing line should always be at the same point for all gravels.

There have been some studies of broken stone and of the proper proportions of sand and stone for stones of various sizes and gradings, and fairly satisfactory concrete specifications for sand and broken stone mixtures of certain sizes and gradings of sizes have been devised. It seems, however, to have been assumed that all other coarse aggregates have the same qualities as the broken stone and they are all lumped together under the specifications for broken stone concrete.

To secure uniformity of product it is necessary that a "Run of Bank" or "of Plant" gravel be separated into at least two parts, a fine and a coarse aggregate, and then be re-combined in some definite pre-determined proportion.

The idea of separating and re-combining aggregates probably originated with the paper of Fuller and Thompson, published in the Proceedings of the Am. Soc. of C. E. in 1907. The principal conclusions brought out by these authors which are directly applicable to the problem of a gravel specification, are these:

1. Artificially graded aggregates give about 14 per cent. better strength than naturally graded ones. (In their tests.)

2. Variations in the grading of the sand affect the strength and density more than the grading of coarse aggregate.

3. The term sand is a "relative" one; with a 2¼-inch stone the best sand ranged from ¼-inch to 00, while for ½-inch stone it would range from .05 to 00.

In view of the fact that the present specifications have little to say as to how the fine aggregate shall be graded and also specify sand of one size only, namely ¼-inch—00, it would seem that more investigation should be made and revision obtained if necessary.

The proper grading of the fine aggregate has not as yet been fully determined. Numerous tests of sands have been published but never with that particular object in view. Professor Schofield has studied the results of some of these investigations to gain some information with regard to the effect of grading on the strength of the resulting mortars.

In the Bulletin No. 331 of Geological Survey, United States Department of the Interior, are recorded the results of tests of twenty-two natural sands and twelve sands screened from gravel deposits. The straight line of "uniformly" graded sand is also given as a comparison for the grading. These sands were all tested under the same conditions and were collected from various parts of the United States. A review of one or two other publications is also given as a matter of more information on the subject.

TABLE I: TESTS OF 22 NATURAL SANDS U. S. GEOLOGICAL SURVEY. *Bulletin No. 331 by Humphrey and Jordan.*

Sand.	Sieve Analyses (Per Cents) 0-80	80-20	20-10	10-¼"	Density	1 to 3 Strength (lb. sq. in.) 360 days Ten.	Com.
"Uniformly'							
Graded sand...	2.7	10.8	15.5	71.0	...	...	....
Average of all...	6.0	56.1	19.7	18.2	.745	542	5073
Coarsest sand....	1.5	30.8	27.5	40.2	.760	605	7108
Finest sand.....	15.3	80.5	1.8	2.4	.676	331	2633
Strongest Sands	2.1	45.0	22.2	30.7	.763	720	7554
	2.1	42.1	26.9	28.9	.789	773	6719
Weakest sands...	15.3	80.5	1.8	2.4	.676	331	2633

TABLE II: TESTS OF 12 GRAVEL SCREENINGS PASSING ¼" SIEVE, U. S. GEOLOGICAL SURVEY—*Bulletin No. 331.*

Sand.	Sieve Analyses (Per Cents) 0-80	80-20	20-10	10-¼"	Density	1 to 3 Strength (lb. sq. in.) 180 days Ten.	Com.
"Uniformly'							
Graded sand...	2.7	10.8	15.5	71.0	...	...	....
Average of all...	3.1	26.7	12.8	54.7	.768	621	6641
Coarsest sand....	0.0	0.0	.7	99.3	.791	654	8567
Finest sand.....	4.5	56.2	11.3	28.0	.759	703	5570
Strongest Sands	0.0	0.0	.7	99.3	.791	654	8567
	1.5	27.1	26.1	45.3	.796	737	7825
Weakest	9.2	6.8	5.0	79.0	...	426	4654

TABLE III: TEST OF 30 ILLINOIS SANDS, ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS—*Bulletin No. 70.*

Sand.	Sieve Analyses) Per Cents) 0-74	74-16	16-8	8-4	1 to 3 Strength (lb. sq. in.) 90 days Tension
"Uniformly'					
Graded Sand...	4.0	17.0	25.0	54.0	...
Average of all....	13.7	69.2	13.5	3.6	289
Coarsest sand....	6.0	42.7	32.8	18.5	428
Finest sand.....	55.6	44.3	0.1	0.0	211

Strongest	5.0	50.0	28.0	16.0	464
Sands	1.1	60.2	36.5	2.2	454
Weakest sand	35.3	64.6	0.1	0.0	140

TABLE IV: TESTS OF WISCONSIN NATURAL BANK SANDS, BY M. O. WITHEY—PROCEEDINGS OF AMERICAN SOCIETY FOR TESTING MATERIALS, 1913.

Sand.	Sieve Analyses (Per Cents) 0-74	74-20	20-10	10-¼"	1 to 3 Strength (lb. sq. in.) Ten.	Com.
"Uniformly'						
Graded sand	2.9	10.8	15.3	71.0		
Average of all	9.1	53.8	16.6	20.5	481	3816
Coarsest sand	3.8	40.7	23.2	32.3	620	4150
Finest sand	18.2	81.7	0.1	0.0	235	1700
Strongest	8.7	40.1	20.9	30.3	710	4800
Sands	0.7	47.0	24.3	28.0	475	4900
Weakest sands	18.2	81.7	0.1	0.0	235	1700

TABLE V: TESTS OF INDIANA BANK SANDS, BY H. H. SCHOFIELD, PROCEEDINGS OF INDIANA ENGINEERING SOCIETY, 1914.

Sand.	0-80	80-20	20-8	8-¼"	Density	1 to 3 mortar 360 days Ten.	Com.
Approx. "Uniformly"							
Graded (Co'rs't)	0.0	6.0	29.0	65.0	.79	546	5542
Next coarsest	20.0	5.0	32.5	42.5	.75	658	6125
Next coarsest	0.0	20.0	40.0	40.0	.75	619	5987
Next coarsest	6.7	25.3	41.2	26.8	.75	555	5640
Next coarsest	15.8	28.7	37.8	17.7	.73	536	5221
Finest sand	40.0	4.0	24.0	32.0	.70	450	4654

TABLE VI: TESTS OF INDIANA BANK SANDS, BY H. H. SCOFIELD.

Sands	0-80	80-16	16-8	8-¼"	¼"-½"	Density	1 to 3 mortar 42 days Ten.	Com.
Medium	40.0	60.0	0.0	0.0	0.0	.661	249	1745
Fine	67.0	33.0	0.0	0.0	0.0	.647	235	1338
Coarse	17.0	83.0	0.0	0.0	0.0	.719	254	2040
	0-40	40-16						
Fine	65.0	23.0	12.0	0.0	0.0	.695	293	1606
Medium	40.0	29.0	31.0	0.0	0.0	.723	347	2035
Coarse	16.0	29.0	55.0	0.0	0.0	.765	373	3470
Fine	58.0	22.0	7.0	13.0	0.0	.706	295	2385
Medium	31.0	24.0	13.0	32.0	0.0	.768	363	3248
Coarse	6.0	10.5	20.5	63.0	0.0	.825	515	3858
Fine	46.0	20.0	14.0	11.0	9.0	.752	438	2473
Medium	20.0	18.0	22.0	11.0	29.0	.788	457	3605
Coarse	3.0	5.5	10.0	31.5	50.0	.813	478	4838

Note: Above values are averages of at least three determinations.

From a study of the foregoing tests, the following points are evident:

1. The average natural sand and gravel screenings are much finer than the so-called straight line or "uniformly" graded sand.

2. The coarsest sand is not necessarily the strongest. The sand whose curve runs just a little above the uniformly graded sand appears to be the stronger in some cases.

3. The finest sands are nearly always the weakest.

4. The amount of material below a No. 80 size, corresponding closely to the size of cement, has a great influence on the strength of the resulting mortar.

5. The sand which gives the strongest mortar in tension is not necessarily the strongest in compression.

6. A sand which is all finer than a No. 80 sieve can give better strength and density than one which grades up to ¼-in. if the former is properly graded and the latter is near the upper limit in its amount of fine material.

What has been said concerning the fine aggregate can also be said with reference to the coarse aggregate, altho variations in grading will probably have less effect on the strength of the resulting concrete. A point with regard to the latter which has special reference to concrete roads is the wearing resistance of concrete and the influences which affect it.

From a review of the abrasion tests of concrete made by Professor Shoop of the University of Minnesota, it is evident that here again the wearing value of the surface of gravel concrete depends to a great extent upon the mortar; inasmuch as when the mortar wears more rapidly than the stones, these loosen and fall out producing pits and pockets. This characteristic might be exhibited in a road surface itself under the action of traffic.

It is very clear that there is need of an investigation for the purpose of fixing a rational specification for gravel for concrete. Such a specification should take into account, among other things, the durability of the particles, the grading, the cleanness and the proportions for different classes of natural gravels and for different classes of work.

The specifications for fine and coarse aggregates for concrete pavements adopted by the American Society of Municipal Improvements in October, 1915, follow very closely the specifications adopted by the American Concrete Institute, with the addition of the Deval Test of Aggregates, and read as follows:

2. Fine Aggregate: Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent. shall, pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent. shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three (3) per cent. of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven [7] and twenty-eight [28] days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The percentage of water used in making the briquettes of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of standard consistency. In other respects all tests shall be made in accordance with the report of committee on uniform tests of cement of the American Society of Civil Engineers.

3. Coarse Aggregate: Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality in graded sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass a one and one-half (1½-in.) inch round opening, and shall range from one and one-half (1½-in.) inch down, not more than five (5) per cent. passing a one-quarter (¼-in.) inch round opening, and with no intermediate sizes removed.

Its "co-efficient of wear" as determined by the "Deval Test" shall not be less than twelve, and its crushing strength shall not be less than twenty thousand (20,000) pounds per square inch.

The methods of determining the proportions of the aggregates to be used differ in the two specifications.

These specifications are typical of the ordinary specification, being somewhat better than the average.

It does not seem possible that a specification using broken stone aggregates, which are supposed to be roughly cubical but are of quite different shapes according to the structure of the stone from which they are made, would fit gravel, the shapes of the particles of which are so very different and the sizes and shapes of the voids in which are also so different.

A comparison may be made with the methods used in determining the grading of sizes to be used in the bitulithic pavement to indicate a method of study of the various coarse aggregates for concrete to show their differences, and therefore the necessity for differences in specifications. In the original studies for that pavement a cylinder was filled with stones of the largest size proposed to be used and they were shaken down until no more could be put in. The voids were then filled with plaster of paris, the mass was carefully disintegrated and the sizes and shapes of the voids between the stones were determined. A size of stone deemed best to fill these voids was then selected and this size of stone was then shaken down into a cylinder full of the large stones until no more could be worked in. The remaining voids were then studied and the process was repeated until fine dust had been worked in. The voids could be reduced in this way to perhaps 5 to 8 per cent. and the proportions of each size had been determined.

Practically each kind of stone to be used in a pavement is studied in a similar manner, except that the number of sizes of stone to be used in making the mixture is reduced to three and the proportions of these three sizes, as well as their limitations of sizes are determined, and the aggregate for the pavement is made up of these three sizes in the required proportions by weight. The voids are naturally in greater per cent. than in the theoretical sample, but they are reduced to a practical minimum.

A similar study of the voids in gravel would soon demonstate the truth or falsity of our contention that they are different in size and shape from those in broken stone and that they require a different proportioning and limits and grading of the fine aggregates.

Indeed, the best results with broken stone concrete require study of the products of the various quarries and crushers to determine the proper proportions and grading of fine aggregates.

Quite a number of studies of sand and gravel have been made for different purposes. That the specification drawn with the data obtained from such investigations should be practical, goes without saying. It is not truly rational unless it is usable in daily practice.

RECORDS OF STREET AND ROAD REPAIRS

In a paper before the American Association for the Advancement of Science, Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, makes a plea for the application of system to street management, from which the following is abstracted:

State highway departments, collegiate institutions, and even the Office of Public Roads of the United States, have deemed it advisable to construct various types of roads, and roads of like type of somewhat different construction, with a view of study, recording data, watching behavior, keeping a correct cost, maintenance and repair charge, comparing wear and tear, in an endeavor to reach some conclusion and gather some testimony as to the value of such roads. The endeavors of these organizations are as nearly practical as possible under existing circumstances, but conclusions are drawn but from one character of travel. The conclusions are reached from conditions that are widely different from those actually existing on our streets as a whole, no two of which bear the same travel.

Streets which are improved are of various types.

They are in various states of repair.

They are of various locations.

Even a single street receives a variety of travel.

Single streets are often of such location that sections receive more or less travel.

The streets overlie varied conditions of soil.

Some streets are susceptible of easy natural drainage.

Other streets must receive artificial drainage.

The choice, the character, the type, the cost of all, are subject to a greater or less extent to whim, to notiou, to low cost, to influence of zealous promoters, to one neighbor selling out another; in almost every case to any consideration other than those upon which good, sound judgment should be based.

Chaotic and inexcusable street aud road mismanagement has been allowed existence because streets and roads are sustained by donation in one form or another; their earning capacity is not held to account. In a commercial establishment, if a like method of conducting business was permitted, the institution would soon fall into bankruptcy.

A business plan of street and road management should be put into operation which would furnish accurate information as to original cost, cost of operation and service, usually designated as maintenance and repair; would supply such supervisory oversight that when a break occurs it could be at once determined whether or not it was due to wear and tear or an original defect in some part; would deal systematically with cuts and openings and replacements and effectually regulate that annoying privilege.

Separate these streets into certain divisions and these divisions into sections, in no case exceeding one mile in length. These sections must be measured, numbered and recorded for the purpose of complete identification. To illustrate: East Forty-fifth street, division No. 9, section 17, beginning at the north property line of Superior and ending at the south property line of St. Clair, including intersections therein, 4,800 feet in length. The information required about this particular section of street can then be definitely recorded and classified and attached definitely to its records. With the full information which it is possible to gather and locate under such a plan, the adaptation of streets of various types and kinds to various service, in a short time will become apparent not only to the student applying a refined study to the situation, but to the layman as well.

Every county should be required by law to establish a complete identification of its roads in divisions not exceeding two miles in length, located by township and section, and such identification should be made of record. In all cases of contract for construction, reconstruction, resurfacing, maintenance and repair, expenditures therefor should be charged against the particular section upon which the expenditures were made. By such a plan of road and street management, the best judgment as to economy of the road could be exercised on account of the ability to trace the dollar to the actual thing purchased or work done for the particular road. Aside from this benefit, data, experience and comparison would become available for judgment as to future construction of roads. Street and road improvement, maintenance and repair would shortly become scientific, systematic, business-like operations, and millions now wasted would be saved.

Comparison of Team and Tractor

FOR HAULING GRAVEL

By O. L. Kipp, District Engineer, State Highway Dept., Redwood Falls, Minn.

A practical demonstration is always convincing. This comparison of hauling costs by animal and by motor power is such a practical demonstration. The article also shows conclusively the intimate connection of the methods of loading and unloading wagons and trucks with the economy of hauling. The motor truck requires much better loading facilities in particular, and when it has them its economy is vastly increased.

THE data that will be presented and the conclusions that may be suggested are derived from the gravel checker's records on five team hauling jobs totaling 22 miles of road gravelled and one tractor-hauling job covering 3.6 miles of road gravelled, the gravel being placed at the rate of 15 cubic yards per 100-foot station on each job.

Gravel hauling by team is familiar to all, and no description of outfit or method is necessary other than the statement that ordinary dump planks were used and one and one-half cubic yards per load were hauled uniformly. The team wagons were loaded by hand shoveling. The number of shovelers in addition to the teamsters shoveling varied from none for a portion of the time on Job No. 1 to a maximum of two on all of the jobs.

The data obtained from the checkers, together with percentages and averages derived therefrom, have been compiled in the attached table in which are shown for each job and each haul length on each job the following data:

Total loads hauled; average number of teams hauling; average number of loads per team day; load miles per team day; percent. of time dumping; per cent. of time in pit; per cent. of time required for loading at 12 minutes per load; minutes actually used in loading each load; per cent. of time lost in loading; average number of teams at the pit; hauling cost per cubic yard; total loading and hauling cost; contract price, and the hauling cost per cubic yard mile for each length of haul.

From the same table we also find that, providing the time of loading were reduced to 12 minutes per load, the hauling cost per cubic yard mile would be as follows: 0 to ½ mile haul, 43 cents; ½ to 1 mile haul, 27.8 cents; 1 to 1½ mile haul, 23.8 cents; 1½ to 2 mile haul, 22 cents, 2 mile haul and over, 21.5 cents. If the loading time could be reduced to six minutes per load, the hauling cost per cubic yard mile would be further reduced as follows: 0 to ½ mile haul, 34.1 cents; ½ to 1 mile, 24.5 cents; 1 to 1½ mile, 21.7 cents, and above that 21.5 cents per cubic yard mile.

Also, on a 12-minute loading basis the cost per yard for the hauls would be as follows: 0 to ½ mile, 13.5 cents; ½ to 1 mile, 20.5 cents; 1 to 1½ miles, 29.8 cents; 1½ to 2 miles, 38.5 cents 2 plus X miles, 44 cents plus 22X miles.

The data in the table warrants these conclusions, for we find in Job No. 2 on the ½ to 1 mile haul the cost was 22.9 cents, with an 8.7 per cent. loss of time at the pit; on the 1 to 1½ mile haul the cost was 29.4 cents, as compared with 29.8 cents as estimated, while on the 1½ to 2 miles haul of Job No. 3 the cost was 38.4, as compared with the estimated cost of 38.5 cents, and on a 2.95 mile haul the cost was 67 cents, with a 12.3 per cent. loss of time, as compared with the estimated cost of 65 cents.

It would thus appear that efficiency in team hauling and consequent low cost is largely dependent upon, and might easily be secured by, obtaining the maximum efficiency in loading. This problem is by no means as easy as that of the hauling, for many varying conditions are encountered. The total loading and hauling cost on the various jobs was figured to provide for the shovelers actually employed and $5 per day ad-

GRAVEL HAULING COST DATA

	0-½ mi.			½-1 mi.			1-1½ mi.					1½-2 mi.				2-2½ mi.	2½-3 mi.	2.95 mi.
Job No.	1	2	5	1	2	5	1	2	3	4	5	1	3	4	5	3	3	1
Total No. loads hauled	407	475	482	327	1571	364	606	525	898	41	746	312	873	434	198	337	267	714
Average No. teams hauling	7.2	5.2	4.5	9.6	7.0	9.0	6.5	7.6	7.0	6.0	8.7	6.4	7.5	5.2	4.6	8.0	7.2	18.7
Average No. loads per team day	12.1	14.0	9.45	9.75	11.67	7.35	7.0	9.1	7.55	7.33	6.0	5.4	6.93	6.73	5.35	4.6	4.0	3.9
Load miles per team day	4.24	4.62	2.83	7.31	8.75	5.51	8.75	11.38	9.44	9.16	7.50	9.45	12.13	11.78	9.36	10.35	11.00	11.51
Per cent. time dump. (5 min. per load)	10.0	10.9	7.8	8.1	9.7	6.1	5.8	7.6	6.3	6.1	5.0	4.5	5.9	5.6	4.4	3.8	3.3	3.2
Aver. actual time in pit per load	30.6	25.0	46.0	26.6	16.5	46.7	30.7	11.0	24.4	24.5	45.0	36.0	11.5	14.2	37.2	36.0	35.1	30.9
Per cent. actual time in pit per load	61.7	58.3	73.3	43.2	32.0	57.2	35.9	16.7	30.7	32.9	45.0	32.5	13.3	15.9	33.2	27.2	23.4	20.1
Pct. time required loading at 12 m. load	24.2	28.0	18.9	19.5	23.3	14.7	14.0	18.2	15.1	14.7	12.0	10.8	13.9	13.5	10.7	9.2	8.0	7.8
Per cent. of time actually lost in pit	37.5	30.3	54.4	23.7	8.7	42.5	21.9		15.6	18.2	33.0	21.7		2.4	22.5	18.0	15.4	12.3
Average No. of teams at pit	4.5	3.0	3.3	4.1	2.2	5.1	2.3	1.3	2.2	2.0	3.9	2.0	1.0	0.8	1.5	2.2	1.7	3.8
Hauling cost per cu. yd. in cents	21.9	19.0	28.3	27.3	22.9	36.3	38.1	29.4	35.3	36.4	44.1	49.4	38.4	40.0	50.0	58.0	66.7	67.0
Total cost cu. yd. cts. loading and haul	29.9	28.0	38.3	34.3	30.9	46.3	49.1	39.4	47.3	51.4	56.1	66.4	51.4	60.0	75.0	76.0	89.7	76.0
Contract price per cu. yd	15.0	39.0	35.0	60.0	50.0	45.0	70.0	65.0	65.0	60.0	65.0	85.0	80.0	75.0	80.0	107.5	122.5	109.0
Spreading cost per cu. yd	2.00	2.25	3.75	1.75	2.00	2.50	3.75	2.50	3.00	3.75	3.00	5.00	3.25	5.00	6.25	4.50	5.75	2.25
Hauling cost per cu. yd. mile, actual	73.0	57.6	94.3	36.4	30.5	48.4	30.5	23.5	28.2	29.1	35.5	28.2	22.0	22.8	28.5	25.8	24.3	22.7
Haul. cost per cu. yd. mile, 12 min. load	43.0	43.0	43.0	27.8	27.8	27.8	23.8	23.5	23.8	23.8	23.8	22.0	22.0	22.0	22.0	21.2	20.6	21.2
Haul. cost per cu. yd. mile, 6 min. load			34.1	24.5			21.7											
Haul. cost per cu. yd. 12 min. for load		13.5			20.5		29.8						38.5					
Haul. cost per cu. yd. 6 min. for load																		

Above figures based on 25c per hour for man alone and 40c per hour for man and team.

ditional for the general superintendence of a foreman or the contractor. The resulting loading costs vary from 7 cents to 25 cents per yard, the lower figures being too low on account of the teamsters acting as shovelers while waiting to get into the pit, and the highest figures being boosted on account of an excessive amount of frost and firewater and poor supervision. The lowest job average for loading was secured on Job No. 2, it being 9 cents per yard. Favorable pit conditions were a large factor in producing this low figure. It would appear that for average Redwood county pits 10 to 15 cents per cubic yard should cover the item of loading by hand. Whether or not some mechanical loader would be able to reduce this item I am unable to state, but would be interested in learning.

The failure to successfully solve this mechanical loading problem contributed in a large measure toward increasing the figures I am able to present on gravel hauling by tractor.

The tractor hauling outfit used in Redwood county consisted of a 30-60 Holt caterpillar gas tractor and a train of 7 Troy 3½-yard reversible spreader wagons, a 50-yard storage bin and a belt conveyor loader.

Difficulties were encountered from the very start. Considerable time was consumed in erecting the storage bin and loader. When the first train was finally loaded ready to start it was found that the tractor would not pull more than two cars over a short sharp pitch at the railway crossing on the most direct route. After some investigation and experimenting, it was found that four cars could be hauled across private fields to the top of a short pitch about three-fourths of a mile from the pit, and that by doubling back for the remaining three cars a train of five cars could be made up and hauled the remaining distance of two and a quarter miles. One thousand three hundred and sixty-five yards were hauled in this way over an average haul of three miles, or a total of 4,125 cubic yard miles, at the average rate of 129 cubic yard miles per day, which, on a basis of $20 per day to cover the cost of operation, interest and depreciation, was at the rate of 15.4 cents per cubic yard mile for the hauling.

From the next pit they hauled a total of 1,584 cubic yards on to a stretch from 1 to 3.6 miles distant, making a total of 3,422 cubic yard miles. There were no grades greater than 2 per cent. on this stretch, and they made an average of 142 cubic yard miles per day on this work, the cost being 14.1 cents per cubic yard mile. In several days they were able to make as high as 216 cubic yard miles, which would be at the rate of 9.2 cents per cubic yard mile.

From the foregoing it would appear that the cost of hauling by tractor was considerably less than by teams. The advantage in favor of the tractor would have been greater, in my opinion, had there been more power available. A 40-80 tractor would have made a much better showing. Another factor cutting down the capacity of the train was the inability of the loading equipment to supply gravel fast enough. With ample power to pull six cars and a train load of gravel always ready when the train arrived at the pit, there is no doubt that the record of 9.2 cents per cubic yard mile made on a few days could have been maintained thruout the job.

However, in tractor hauling it is essential, as I have suggested, to have a bin full of gravel ready to dump into the cars quickly when the train arrives at the pit, for the outfit cannot make any money while waiting to be loaded. A bin of from 25 to 30 cubic yards capacity must be provided. The bin must be portable, easily transported from pit. This portable feature is essential for the loading apparatus also. Unfortunately, my experience in this instance does not prepare me to tell you what equipment is practicable, but I can tell you that a belt conveyor and a non-portable bin are not practicable, for I've seen them tried, and the cost of tearing down, moving and re-erecting the bin amounted to fully 10 cents per yard of gravel handled. The belt conveyor may be successful on a level grade or a very slight incline, but when it comes to raising the gravel about thirty feet vertically, you have gone beyond the practical range of a belt conveyor. I have no definite data as to the cost of loading with this apparatus, but, as nearly as I can estimate, it was between 25 and 30 cents per yard, which, together with the cost of moving the bin, makes a total loading cost of 35 to 40 cents per yard.

It would seem, with the proper equipment, the total loading cost should not exceed 10 cents per cubic yard. If this is possible, the comparison between tractor and team hauling is very much in favor of the tractor.

Besides the cost, there are other features in favor of the tractor hauling which I wish to point out briefly. First: By applying the gravel in two courses with a tractor you get your gravel rolled without additional cost, and the road is ready for travel as soon as the gravel is applied, instead of a month or more later, as with teams. Second: By loading into a bin, thence to wagons and thence to the road, you obtain an efficient mix of the materials so that instead of having one load with good gravel with a fair amount of binder followed by a load of sand with no binder and the resulting hard bump and chuck hole a few weeks later, you have a gravel of uniform consistency which does not tend to develop waves or chuck holes.

MANAGEMENT OF NEW YORK'S MUNICIPAL FERRIES.

For ten years the city of New York has operated two ferries under municipal ownership, one to Staten Island and one to Brooklyn. The former is practically the only medium of communication regularly, while the latter is a supplement to bridge and tunnel service.

Until two years ago there was much criticism of the management because the ferries were run at a large annual loss. Handsome terminal structures were erected, which were also criticised because of their high cost. The present administration of the department of docks and ferries has been in office nearly three years and has changed the deficit of $289,816 in 1913 to $132,133 in 1914, and a profit of $135,334 in 1915. This profit was made altho there was a decrease in gross earnings of $23,000, because at the same time there was a decrease in operating expenses of nearly $164,000.

No account is made of interest or depreciation in these figures, the beauty and permanence of the public structures and the character and quality of the service being so much more than they would be under private ownership that they are considered to be equivalent in value to the amount of these items.

The reduction in revenues was due to a free transfer agreement with the street railway at the foot of Whitehall street, fare being divided between them, and the arrangement not resulting in the prompt stimulation which was expected. If the city had received the whole fare, its receipts would have been increased about $116,000.

If interest and depreciation are counted, the deficit in 1915 would be nearly $500,000. If the improvement in conditions continues, this deficit will also be wiped out.

The reductions in expense show a saving of $112,000 in fuel, $99,000 in reduction of operating force on the Brooklyn division, $64,000 by removal of repair shops to the Staten Island terminal and omitting accident insurance.

The average number of passengers carried per trip on the Staten Island ferry has increased from 201 in 1906 to 314 in 1915, the maximum carried in one day being 139,446, on July 18, 1915.

CONCRETE ROAD CONSTRUCTION

IN OAKLAND COUNTY, MICHIGAN

By M. De Glopper, County Engineer, Pontiac, Mich.

This is a practical article by the man in charge of the work which goes into detail as to the methods of construction and it will be of great value to the engineer or road superintendent who has the supervision of concrete road construction as well as to the contractor doing the work.

The highway whose construction is here described is on the Woodward Avenue road, so called, being a continuation of Woodward avenue, Detroit, in Oakland county, adjoining Wayne county on the north. The length of highway constructed was: Section 1, 4¼ miles; Section 2, 1 1/3 miles. Average traffic is 1,800 vehicles per day, mostly automobile and motor truck traffic, the latter being very heavy. Funds were secured by direct taxation, the county road rate being two mills, and the valuation of county, $58,000,000.

The dimensions of the cross-section were: Width, 16 feet concrete, 24 feet between shoulder lines; depth, 8 inches in center, 6 inches on sides; rate of crown, ¼ inch per foot.

The unit prices of the accepted bid were as follows:

	Section 1	Section 2
Grading and ditching, per 100 ft.	$ 14.22	$ 20.00
Concrete, per sq. yd.	1.27	1.13
Baker armor plate joints, each	1.67	1.67
4-in. hard-burnt land tile in place, per ft.	.10	.10
12-in. vitrified tile in place, per ft.	.40	.40
Concrete in culverts, bridges, etc., per cu. yd.	6.00	7.00
Reinforcement for bridges in place, per lb.	.03	.03
Catch basins with covers complete, each.	25.00	15.00
Extra work above cost.	10%	10%
Total price in lump sum.	$59,674.27	$16,355.67

The officers in charge of the work were: John Adams, of Leonard, Thomas Lytle, of Farmington, and Robert Garner, of Pontiac, commissioners, and M. DeGlopper, Pontiac, Mich., engineer.

Drainage—Considerable expense was incurred in laying a tile line along the entire length of the road because of the presence in the highway of a double-track interurban line, reducing the available width to a minimum and prohibiting the construction of adequate open ditches. Besides, the general contour of the ground would not permit satisfactory surface drainage. The tile were laid well below the frost line at an average depth of about 3½ feet, catch basins being included at frequent intervals for diverting the flow into its proper water course. Open grate covers permitted the entrance of all surface water from the shallow gutter above. The pipe joints were partially sealed by a single wrap of tar paper to prevent excessive seepage of earth into the drain.

Grading—The original surface consisted of a well-compacted but worn-out gravel road, the sub-soil varying from a light blow sand to heavy retentive clay. No excessively large cuts or fills were encountered and comparatively all the grading was done by use of scarifiers and graders, followed by a force with picks and shovels to perform the fine grading.

The rolling was continuous across the entire sub-base, care being taken to produce a bottom of uniform hardness in which there would be no variation of bearing power and capillarity. Excessive compacting in the middle or sides was guarded against in an effort to overcome as much as possible the formation of longitudinal cracks due to this variable-bearing factor. Non-uniformity in hardness of the supporting soil offers a great inducement to cracking because of heaving, the concrete having little strength to offset the tensile and shearing stresses set up within it.

Grade stakes were set for both the rough and fine grades in the center and on the sides of the roadway at intervals of 100 feet, the intermediate sections being teed in.

Requirements of the Concrete—Specifications called for a one-course pavement mixed in the following proportions:

American portland cement	1 part
Clean sharp sand	1½ parts
Broken stone or gravel	3 parts

All cement used in the work was required to stand the rigid tests covered under the standard specifications adopted by the Am. Soc. C. E. Inspection service was performed under our direction by the Pittsburg Testing Laboratories of Detroit, at a cost of 3 cents per barrel. Samples were taken from car lots at the mills and results reported on 24-hour and 7-day tests. Complete daily reports were kept by the local inspector on the work and I believe that the additional expense incurred was meritorious in securing the assurance of the use of high-grade materials. The testing service cost approximately $100.00 per mile of road.

The fine aggregate consisted of clean, sharp sand free from loam, clay or other foreign matter and containing voids not to exceed 33 per cent. as determined by saturation. It was graded from fine to coarse, the latter predominating, and all required to pass a ¼-inch screen.

The coarse aggregate consisted of screened washed gravel graded in size from ¼ inch to 1¼ inches and free from clay or vegetable matter.

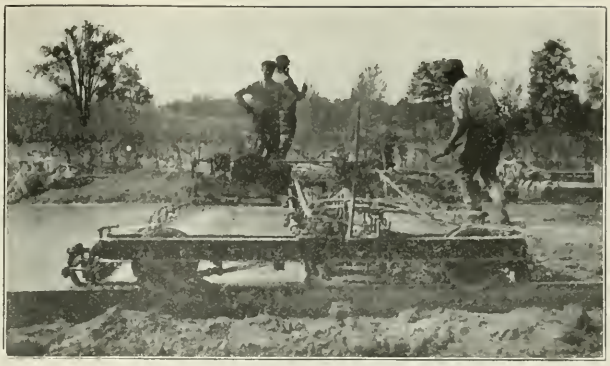
Handling of Materials—The use of bank-run gravel being prohibited, it became necessary to install a combined washing and screening plant. Extreme care was used in the care of the aggregate, removing all possibility of danger from clay coating and fine powdered sand. All gravel was shipped in by rail, no local material being available, and delivered directly in hopper-bottomed cars to the plant. After dumping into a track hopper, having a depth of about 7 feet, the gravel was carried to the hoisting bucket elevator over an apron conveyor. The total lift from hopper to screens was about 27 feet.

The particular plant used, as shown in the illustration, was of the Weller type, equipped with two storage bins for sand and pebbles, having a capacity of 100 tons each. The operating power was furnished by a 5-h.p. motor, the water being pumped thru a 3-inch main having a vertical lift of about 35 feet. Principal, perhaps, among the advantages to be derived from the use of this type of plant, is the possibility of discharging the waste water at the end of the screen at which the gravel enters. With this arrangement, the dirty water never comes in contact with the clean material. Sliding gates in the bottom of the bins admitted easy and rapid loading.

In all probability, no one factor has more influence over successful construction than the factor of the transportation of the material itself. Reliance upon favorable weather conditions has proven disastrous to many contractors. The past season was a particularly bad one, causing the loss of nearly forty actual working days. Under such conditions wagon or tractor haul is an impossibility, resulting invariably in utter

destruction of the sub-base. Traffic in a confined wheelway leaves that portion of the base so compacted that the desired uniform bearing power is impaired and longitudinal cracks are bound to appear. Ruts cut into the road, even if refilled, are never returned to their proper condition, leaving holes for retaining water under the sub-base. What is true of the use of wagons and tractors is equally true of motor trucks and trailers.

There is only one practical method of transporting materials of construction over a sub-base, providing the magnitude of the work warrants its adoption. This method is by use of the narrow-gage industrial railway. With its use, the sub-base is not subjected to any wear, the compacting effect is well distributed, and the weather conditions can well be disregarded. A greater saving in cost and time, delivery of more material in a shorter period on account of increased speed and tonnage capacity, requires less working space and can be used in carrying other materials of construction besides aggregate, etc. These are only a few of the many advantages to be derived.



BAKER FINISHING MACHINE, SHOWING TWO TRUCKS, WHICH RUN ON SIDE RAILS, SUPPORTING OSCILLATING STRIKE, VIBRATING AND COMPRESSING PAN, AS WELL AS FINISHING FLOAT, WHICH EXTENDS FULL WIDTH OF ROADWAY.

On our work, all material is delivered to the job by means of a Koppel hauling outfit, consisting of tracks, engine and cars. The portable rails are mounted on steel ties built up in sections and connected by simple slip shoes. Strong brackets and clutch bolts hold the rails securely to the ties, which are wide enough to distribute thoroly the bearing weight of the load. The gage of rails is 24 inches. The cars, twenty in number, are of the two-way, side-dump, rolling-bearing type, each having a capacity of $1\frac{1}{2}$ yards. No loss of time is experienced in loading or unloading and the material is placed far enough away from the rails to prevent constant derailing. The engine is a standard Koppel dinky, rated at 20-h.p. and weighing about 7 tons. The center of gravity being very low, good tractive results are obtained in pulling heavy loads.

The work performed by the outfit during the past season has been very satisfactory in spite of the fact that conditions were not favorable to low unit costs. The long haul did not exceed 3 miles and the actual operating time of the outfit was consequently reduced. Actual cost of transportation was about 20 cents per yard mile, but this could easily be reduced to 15 cents under favorable conditions.

The aggregate was dumped directly upon the sub-grade, the fine and coarse material being kept separated. The total amount of material delivered per hundred feet was 36 yards of pebbles, 19 yards of sand and 60 barrels of cement.

Side Rails—Just prior to commencement of mixing operations, the side rails are laid to grade, extreme care being taken to get corresponding side rails at the same elevation. The rails are set on stubs driven into the ground at sub-base level and held in place by means of steel pins having eccentric axis. We use only the Baker type of indestructible rail, consisting of 12-foot channel lengths, 6 inches in depth, and having a weight of 8 pounds per linear foot. These rails are particularly well adapted for county road work, and are a distinct improvement over the old type of wooden rail because of their rigidity and easiness to place in position. Connections are made between sections by means of a fish plate securely locked with an eccentric pin.

The old style 2 by 6 plank rails are unwieldly and unreliable. They require stiff bracing to prevent bending and are always more or less open at the joints, permitting the loss of mortar.

Mixing and Placing—The mixer in use on our work is a No. 16 Koehring, having end automatic loading skip. It is fitted with the improved batch meter and regulator, which proved to be considerable of an advantage. The uniformity of the mix was kept quite constant, the length of time specified for each batch to remain in the drum being 45 seconds or equivalent to 12 revolutions.

The sub-base was thoroly sprinkled to prevent loss of moisture and too rapid drying before the initial set had taken place.

The consistency and quality of concrete produced received close attention and every effort was made to procure uniformity. The only variation was that made necessary by an occasional supply of over-sized coarse aggregate. In this case, a small increase in the sand or a corresponding decrease in the stone content was made to prevent danger from not having the voids thoroly filled. No variation should be made in the cement content and with a $1:1\frac{1}{2}:3$ mix better general results will be obtained by keeping the cement and sand constant and varying only the pebble content when absolutely necessary. The attempt was made at all times thoroly to fill the voids and have enough excess mortar to provide for making a top which would be impervious. Excess mortar should never be greater than 10 per cent. A concrete containing just enough mortar to fill the voids cannot be finished properly and seepage will result in localization of the coarse aggregate, leaving exposed stone on the surface, tending to induce pitting and ravelling. Lack of sufficient mortar and dryness always requires retempering, destroying the bonding characteristic of the cement and causing flaking and rapid wear on the surface. A non-uniform consistency or density, allowing variable degrees of stress thruout the mass, will soon result in cracking or perhaps even disintegration.

All the arguments regarding consistency, excess mortar, density, finishing and curing are closely allied with the subject of wet and dry mixes and moisture content. The public impression has always been to construct the road with wide joints to allow free expansion and prevent buckling, a form of rupture that cannot be caused by or attributed to this cause. The subject of moisture content is one very worthy of consideration, altho many authorities still insist on reckoning mainly with temperature changes. It is very doubtful whether the latter evil, with its very small characteristic of elongation and the frictional resistance presence in the sub-base, is worthy of any consideration at all, only in so far that in working in conjunction with the stresses due to moisture content, it may increase liability of fracture. Increase in moisture content, smooth sub-base, conditions allowing free movement, and drain-

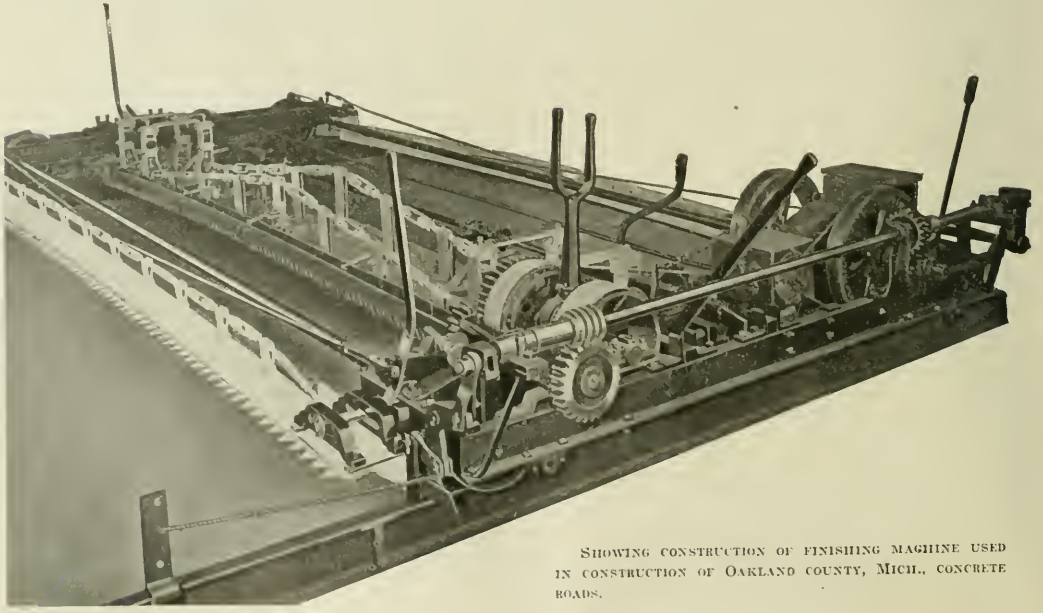
age factors are undoubtedly the causes of practically all of the cracking. I think that if some of the attention which is now being directed towards the concrete itself, was directed, instead, towards producing better and less moisture-retentive sub-grades that better results would follow.

Joints—The subject of expansion and contraction brings us face to face with the matter of joints. Cracks must and will appear in all concrete roads. The question of whether we shall include making them at the time of construction or allow nature to provide them by following the zig-zag line of the least resistance has long ago been decided, at least in sections of the country having as variable a range of temperature as experienced in Michigan. The only question with us is, shall we give our joints the adequate protection due them. For light traffic, perhaps a good felt-filled joint will suffice, but where the roadway is being constantly subjected to heavy shocks this will not be found sufficient. We are using the Baker armor plates with good success. These consist of two plates, 15 feet 6 inches in length and ⅛ inch in thickness, with a strip of tarred felt extending to the bottom of the concrete. The plates are made of a mild steel so beveled on the edges that they will wear evenly with the adjoining concrete. Traffic shocks on the joints are transmitted into the block itself instead of horizontally along the surface where a shearing stress would cause crumbling. The bars are supplied with shear members projecting from, and a part of the bar itself, removing liability of raising or misplacement. The successful use of these joints depends solely upon the care exercised in their installation. We are using the Baker installing device on our work, decreasing to a considerable extent the errors due to carelessness.

Finishing—Perhaps more dissatisfaction has arisen over the manner in which concrete roads have been finished than over any one other detail of the work. The first test given to a road after it is thrown open to the traffic of the public is to determine its smoothness. On this one feature the work is very often either approved or condemned and not always is this determination in error. It cannot be expected that any road finished in a slip-shod manner and containing raised joints and a wavy surface, has received the attention in the other details in accord with good engineering practice. A serious mistake or carelessness in one detail means usually the same exercise of bad judgment in others. The old saying, "a chain is no stronger than its weakest link," can well be adapted to a concrete road. If the sub-base is wrong, the road is bad; if the concrete is not uniform, the road is not strong; if the finishing is bad, the road will not wear properly. What affects the appearance of the road usually affects the construction of the road itself.

The striking and finishing is an operation which calls for the maximum skill on the job, and it is on account of this unreliable factor of human carelessness that so much unsatisfactory work has been put in. But perhaps there is still an opportunity to secure release from this element. The Baker improved automatic finishing machine, now on the market, means much for the advancement of concrete construction. We have used this machine on all of our work and cannot give it too much commendable praise. It is not a new-fangled idea built according to theoretical requirements, but is based upon good practical ideas gained from broad experience in the construction field. It is not complex but is efficient, labor-saving and economical. Its demonstration on our work was thoro. I have received so many inquiries for information concerning the practicability of the machine that perhaps an explanation of its construction and operation will not be amiss in this article.

Referring to the illustration, it is noticeable that the machine contains four separate and distinct features, all of which act as a unit on the work. These features are the oscillating strike, the vibrating and compression pan, the agitator, and the finishing float, each of which performs its function in the natural order. The entire mechanism is mounted on two trucks which run on the side rails previously mentioned. Each feature is adjustable to meet different requirements for crown or density. It operates under its own power, a 3-h.p. gasoline engine mounted on one of the trucks transmitting the power necessary to operate the strike, pan and float, and also the power necessary to propel itself along the surface. This for-



SHOWING CONSTRUCTION OF FINISHING MACHINE USED IN CONSTRUCTION OF OAKLAND COUNTY, MICH., CONCRETE ROADS.

ward movement is obtained by tension cables attached to the side rails some distance ahead of the machine and passing over revolving drums on the machine itself. By means of levers, the strike, pan and float may be raised or lowered to decrease or increase the compression and vibration required upon the particular material being finished. After thoro compacting and levelling, the float produces the final finish.

The complete weight of the machine is 3,600 pounds, and the total compressive force upon the concrete may be adjusted to any portion of this weight. With a 1:1½:3 mix, such as is usually used on high-class work, the machine operates best with a compressive weight on the pan of about 2,500 pounds. As the size of the pan itself is 15 feet 6 inches by 22 inches, the compressive pressure per square foot of area is about 85 or 90 pounds neglecting axle friction. With this compression, aided by continual vibration of the pan, a concrete is produced which is of the most uniform density possible to obtain. The discouraging element of repairs is practically removed, there being no intricate mechanism outside of the gasoline engine itself. On the 5½ miles of road we constructed, the precaution was not even taken of keeping a hand float on the job for emergency use.

Perhaps a better idea of the advantages of this machine can be drawn by means of a comparison between the hand and machine methods of finishing. First, consider the merit and concrete requirements of the old method (hand strike and finish):

1. A very wet and even sloppy consistency of concrete is usually maintained in an attempt to force the filling of the voids. This leaves many weakening invisible pores, increasing the possibility of high moisture content.

2. A very wet mix is necessary to provide sufficient time for tamping, striking and floating before the initial set takes place.

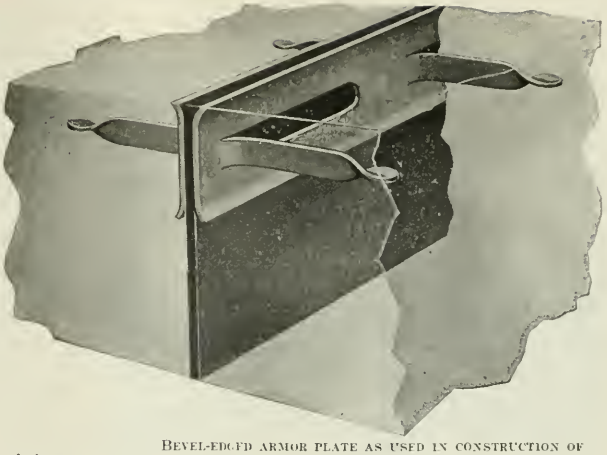
3. The wet mix, when used, produces a wavy surface, especially on grades, the tendency being for the mortar to creep away from the crown to the sides or bottom, leaving a flattening effect. This is contrary to specifications, but is unavoidable with a wet mix. Most specifications require a concrete to be so plastic that it will flush readily under light tamping and at the same time to be so dense that there will be no separation of the mortar from the aggregate. This is inconsistent. One condition or the other must prevail.

4. Hand striking and floating is slow, tedious and expensive work, requiring at least four or five men for this part of the work.

5. Inability to finish the surface as fast as the concrete is placed on the sub-grade very often results in the necessity of retempering the surface for smooth finishing. This retempering, resorted to after the concrete has started to set up, very often destroys the bonding characteristic of the cement and causes rapid wear and dusting on the surface.

6. Hand floating leaves a deceiving surface. It may appear to be smooth, but the presence of numerous small depressions is discernible upon the evaporation of the water. Quite often while the floating is being done, these depressions are replenished with a little additional concrete or mortar. This does not leave a proper bond between the depression already floated and the added material, which is liable to form a crust.

7. In hand tamping, as usually performed in conjunction with the striking, the compressive force can only be applied to a very small surface at a time. As soon as the tamp or strike is raised, the mortar and excess water rush into the depression formed, leaving a surface which is not uniform in consistency.



BEVEL-EDGED ARMOR PLATE AS USED IN CONSTRUCTION OF OAKLAND COUNTY, MICH., CONCRETE ROADS.

8. The principal reason for advocating a wet mix is that no tamping will be necessary and consequently the workmen will not be compelled to walk on the concrete. The advocacy also implies that the weight of the material and fluidity of the mortar will furnish the required density.

9. The placing of an excessive amount of concrete results in the riding of the strike and increases the labor in floating and the attending chance for surface waves.

10. To secure satisfactory results, the operation of the strike must be repeated at least two or three times over the entire area.

11. The attempt to secure a hard surface is often made at the sacrifice of a true crown, the tendency being to rub the material out until the surface is flat.

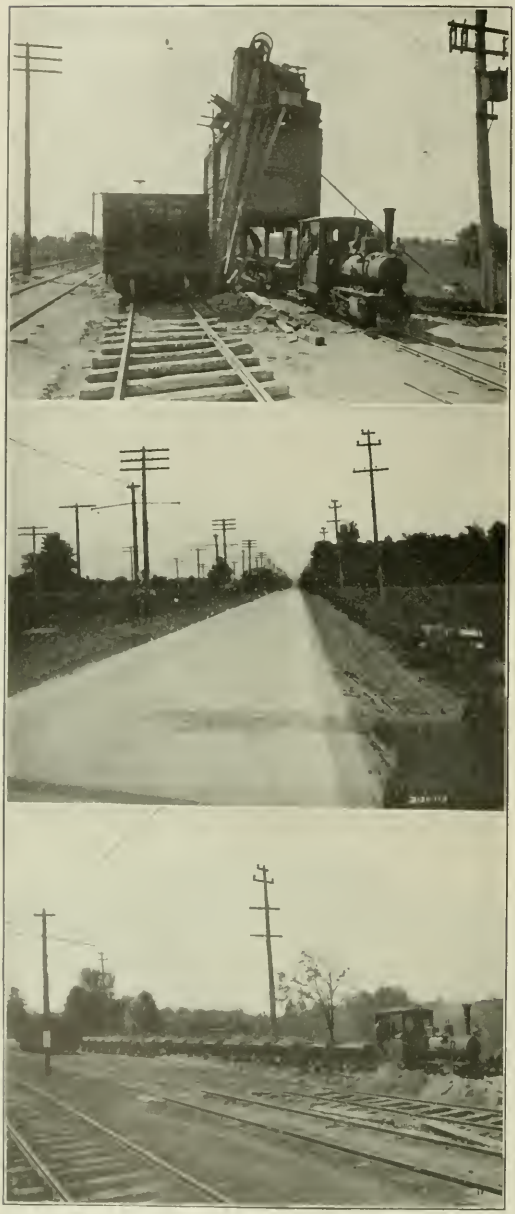
Conclusions to be drawn from the abuses of the hand striking and floating method lead in most cases to faults due to the very wet mix used and to the element of human labor. If these conclusions are correct, then why should we refuse to believe that any other method of performing this work, after the two faults mentioned have been removed, is likewise improper? From careful observation, I have drawn the following conclusions on the advantages to be secured by use of a mechanical means of finishing and striking the concrete:

1. It is entirely unnecessary to use a wet mix, in fact, a more dry mix is very advisable. This will greatly increase the ultimate strength of the concrete. The consistency can be

2. It is not necessary to increase the water content to our roads in 30-foot sections between the joints and the total allow sufficient time for striking and floating. We construct maintained uniformly thruout.

time necessary to strike, compress and float each section is 15 minutes. Instead of waiting for the finishers to catch up, the machine is waiting for more concrete. We have only been able to lay 600 linear feet of roadway per day, and consequently do not know what the real capacity for work of the machine would be. However, it is safe to place this figure at from 900 to 1,000 feet per day.

3. Waves in the surface are dispensed with. The strike moves transversely and leaves just enough excess concrete for compression to the final grade. The compression pan is placed at a slight angle to permit a more uniform and gradual compression on the concrete. The material under the pan at all sections receives the vibrated compression for a period of about 1 minute and more if desired. After the pan has passed



WASHING PLANT AND TRAIN, AS USED BY CONTRACTORS ON OAKLAND COUNTY, MICH., CONCRETE ROADS. CENTER VIEW SHOWS COMPLETED PAVEMENT ON WOODWARD AVE., BETWEEN ROYAL OAK AND BIRMINGHAM.

any section there are three noticeable features apparent at once, (a) none of the coarse aggregate is exposed at the surface; (b) there are no collections of water on the surface; (c) just enough excess mortar has been brought to the surface to provide a smooth, strong, impervious covering. The surface is left in an ideal condition for the finishing float which follows. After the completion of the float's work, the appearance of the surface is self-evidence of the completeness of the task. Not a wave in the surface, a perfect crown across the entire width and no exposed aggregate.

4. Compare the cost itself of striking and floating with that involved in the other method. The hand method requires at least four or five men. By the use of the machine, only one attendant is necessary, and it might be added that the only necessary qualification he must possess is a willingness to take an interest in the work. Any man who can operate a gasoline engine can operate a Baker finishing machine.

5. Possibility of speedy work removes the possibility of having to resort to the abuse of retempering.

6. The vibrative compressive force takes place over a wide section and there is no flow of mortar into a section previously compressed.

7. A wet mix dispenses with tamping but weakens the concrete. On a more dry mix the machine produces this tamping, resulting in a very dense concrete, free from practically all air bubbles and seepage voids without a separation of the mortar and aggregate.

8. It is impossible for the machine to ride the concrete, the trucks being fitted with bracket scrapers mounted ahead of the wheels to keep the rails clean. Consequently, there is no tipped effect and the road must be down to the proper grade across the entire cross section.

9. Only one forward operation is necessary for thoro completion of the work. There are no reverse speeds on the machine.

10. The vibration produced is crystalline in effect, leaving a surface that is hard, smooth, dense and impervious. The finished work is practically monolithic in structure.

11. No appreciable time elapses between striking and floating, as occurs in the old method. From the time any section has been subjected to striking until it is floated and completed but $2\frac{1}{2}$ minutes have elapsed.

The machine will do all that is claimed for it and more cannot be expected. Engineers, contractors or road commissioners interested in the advancement of concrete road construction should investigate the merits of this machine from an economic as well as an efficient standpoint. The time is not far distant, perhaps, when its use will be included and called for in first-class specifications. Discontinue trying to specify some of the ambiguous requirements for variable consistency, striking, tamping, finishing from a bridge, retempering, etc., by merely inserting a clause in your specifications: "Machine finish required."

Reinforcement—We believe in the feasibility of using reinforcement in our concrete roads. The concrete is subjected to considerable tensile and shearing stress, occasioned by high moisture content, temperature changes, lack of uniform density, defects in sub-base conditions or drainage difficulties. Regardless of whether the insertion of this fabric in the concrete will prevent all cracks or not, I believe that the precaution taken against their opening up and the disintegration of the material along the cracks, justifies its use. On our work we have been using Kahn mesh, a cold drawn steel fabric. It is endeavored to keep this fabric at a depth of 2 inches from the top surface. Carelessness in placing the steel is the greatest fault to be found with its use. We reinforce only the middle 10 feet of our 16-foot roads, believing that this will take care of practically all the longitudinal cracks without having a bad effect upon the sides caused by heaving of the sub-base. Shortage in funds to meet the cost of the material

necessitated the cutting down on the width desired. If the steel will act as a distributer for tensile stresses set up within the concrete, there will be less liability of fracture due to the subsequent contraction.

Shoulders—No attempt was made during the present season to complete entirely the additional 8 feet of width comprising the shoulders. The material available was not of the most satisfactory nature and it was deemed best to forego completion so that the shoulders would receive the benefit of a winter's settlement. In all probability, it will become necessary within a short time to furnish additional turnout space on each side of the concrete by channelling to a width of 2 feet on each side and refilling with stone or gravel. This will serve to prevent washing along the concrete, forming of ruts and the liability of allowing water to get into the sub-base.

Curing—The curing of the concrete road received due attention. Not later than the morning following the placing of the concrete, the surface is thoroly wetted and it is endeavored to cover same with earth at once. The sprinkling is continued for a period of about 1 week if weather conditions demand.

The importance and necessity of keeping the road in a wet condition so as to prevent excessive and rapid shrinkage resulting in high contractive stresses, is recognized, and altho we have endeavored to give this phase of the work all the attention due it, we intend to follow more closely the strict requirements necessary. Roads are kept closed for 21 days.

1916 Outlook—During the season of 1916 we will construct, by contract, an additional 4½ miles of concrete road, forming the last link connecting the cities of Detroit and Pontiac and furnishing a continuous pavement for 25 miles thru a picturesque country. Many of the construction features on this work will require constant attention, due to the rolling grades and soil conditions. Grades as high as 6 per cent. on finished road will be encountered. The work will be executed under contract, the same as during the past season, the award having already been made at a total approximate price of $63,000. Unit prices are higher on this work, the advancement being due to increased cost of materials, heavy grading and scarcity of labor.

New Bridge for Johnstown, Pa.

Johnstown, Franklin boro, the Cambria Steel Company, the Pennsylvania Railroad and the Johnstown Traction Company will share in the payment of the cost of a new overhead bridge across the Conemaugh river which will take the place of the structure which collapsed recently.

The traction company will bear between 50 and 60 per cent. of the entire cost of the new bridge, which cost, it is estimated, will amount to between $175,000 and $200,000. Just what percentage of the balance of the cost each of the other four will pay has not been determined.

The plans drawn by A. B. Curry will be used as the basis for the completed plans of the proposed bridge. Curry's plans call for a concrete structure about 1,000 feet long. It will be an extension of Maple avenue and will cross the river at an angle, touching the Franklin side of the stream about 200 feet above the point where the wrecked bridge touched.

As planned at present it will have three arches. One will be over the Pennsylvania railroad tracks, eliminating the grade crossing which made the other bridge dangerous, and there will be two other arches over the river, the plan being to have one pier in the center of the stream. The top of the arches will be about 60 feet from the river bed, so that there probably will be no trouble in getting the consent of the water supply commission to the building of the bridge.

Franklin boro, the Cambria Steel Company and the Pennsylvania railroad and the traction company have been considering the erection of a bridge for some time, and the collapse of the city's structure brought matters to a head. The city was not consulted before yesterday, as the four parties to the original agreement intended to build the bridge independent of the city's aid.

Preliminary plans for the bridge, by a curious coincidence, were mailed to the water supply commission a few hours before the Maple avenue bridge collapsed.

The plans as submitted, however, probably will be revised. They provide for a 40-foot roadway and 6-foot sidewalks. The additional cost would be about $15,000 or $20,000, and this amount split up among the five will not add materially to any one's share of the cost, but it would insure a bridge which would accommodate the traffic for many years to come.

Durability of Brick Pavements

In a discussion on roads around the Ashokan reservoir before the Municipal Engineers of the City of New York, Alfred D. Flinn, deputy chief engineer of the board of water supply, had the following to say:

"As to the durability of brick. The kind of surface that should be used for the Ashokan roads was investigated in 1911 and 1912. I remember distinctly finding one stretch of old brick road, in West Virginia, near the Ohio boundary—not of the modern paving brick, but an old-fashioned, small brick of fire-clay, laid on sand with little skill, which was and had been for years bearing heavy traffic in a manufacturing district. It was twenty-seven years old and still in good condition. Altho not a perfect pavement, it was a much better road than many a newer pavement of other kinds I have seen in other places. In another town I found a street of vitrified shale paving blocks, which looked remarkably good. I asked if this street had been paved last year. They told me no; that pavement was laid sixteen years ago. It looked nearly perfect. I also found many other well-laid brick pavements in excellent condition after ten or more years of service, in city streets and on country roads. Many persons were found ready to say that a vitrified brick block pavement, well laid, was thoroly good for twenty-five years, except under the very heaviest concentrated city traffic—unless abused by being dug up and improperly replaced.

"Portland cement grout is preferred to a soft filler for the joints of brick paving. Wire-cut lug blocks are preferred to repressed blocks; all the examples I examined showed a more perfect pavement wherever square-edged blocks had been used than where the repressed blocks with rounded edges had been chosen.

"Mr. Thomes spoke of the transverse expansion joints, so called. If any of you go to Kingston, N. Y., and inspect the miles of recently-laid vitrified brick block pavement in that city, you will be able to pick out very readily the transverse expansion joints. Within two or three years after that pavement was laid, the city engineer told me they were distinctly sorry that they had made any such transverse joints, as these joints were the only parts of the pavement giving trouble."

Municipal Improvements for 1916.

What the Cities and Counties of the United States expect to construct during 1916.

THE following tables give estimates of public improvements which will probably be made during the construction season of 1916. They cover the various kinds of street paving, sidewalks, curbs and gutters, sewers and sewage disposal, water works, ornamental street lighting, bridges, garbage disposal, buildings, machinery and supplies. Under the headings of "Miscellaneous Street Improvements" and "Comparisons with Conditions in 1915" will be found much interesting information regarding prospective work and conditions in the business field, more particularly as they affect municipal improvements. The tables are arranged in the following order: Street Paving: Asphalt, p. 146; Aspjhaltic or Bituminous Concrete or Macadam, p. 146; Bitulithic, p. 147; Brick, p. 147; Concrete, p. 148; Concrete with Bituminous Top, p. 148; Granite or Sandstone, p. 148; Gravel Streets and Roads, p. 149; Oiled Streets or Roads, p. 149; Wood Block, p. 150; Miscellaneous Street Improvements, p. 150. Sidewalks, p. 150. Curb and Gutter, p. 151. Sewers and Sewage Disposal, p. 153. Water Works, p. 154. Ornamental Street Lighting, p. 155. Bridges, p. 156. Garbage Disposal Plants, p. 157. Public Buildings and Other Structures, p. 157. Machinery and Supplies tohe Purchased, p. 157. Comparison With Conditions in 1915, p. 157.

It will be noted that many cities are not included in these tables. This is due to three causes: Among the larger cities many have not yet laid out their work for the year, so that they are unable to make any reasonable approach to an accurate estimate; among the smaller cities, elections are largely held in the spring months and the year's program is not made out until the appropriations are made and the ordinances are passed by the new councils, late in March, in April, May, and even as late as June; there is this year a larger number than usual of the small cities which expect to do no work, either because prices are high or general business conditions are not yet sufficiently promising, or they have done so much in recent years that they must stop to take breath before starting anything new.

It is worth while to publish this advance estimate because it is made by the men on the ground in each city and gives an early idea of what is in prospect, even if it does not include every city or all the work which will be done in those listed.

Following is an explanation of the abbreviations used in the list:

a—Choice of material not yet made. b—Paid for with bonds. c—Work done by contract. co—County. c. y.—Cubic yard. d—concrete curb. e—Flagstone walks. f—Linear feet. g—Constructed by the state. h—Ctone curb. i—Brick sewers. j—Concrete sewers. k—House connections. l—Contract let. m—Work done by city by day labor. p—Paid by property owners. r—Riveted steel water mains. s—Will be let this spring or summer. v—Vitrified segment block sewers. w—Wooden water pipe. x—Segment block.

STREET PAVEMENTS—1916.

ASPHALT.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
California—				
Anaheim		66,000	c	4-15
Petaluma		3,000	m	
Santa Rosa		4,000	m	
Idaho—				
Moscow		25,000a	c	4-15
Illinois—				
Berwyn	158,400	88,000	c	
Moline	101,176	36,000	c	4-1-16
Oak Park	7,045	2,550	c	
Indiana—				
Anderson		18,000	c	3-20
Bluffton		12,000	m	
Gary		20,000	..	
Goshen		36,000a	..	
Laporte		40,000	c	
Logansport		17,000a	..	
Muncie		23,862a	..	
Richmond		12,000	c	3 or 4
South Bend		140,262a	c	
Wabash		6,000	c	5-1
Iowa—				
Centerville		30,000a	c	
Cherokee		90,000a	c	
Creston		60,000a	c	
Forest City		25,000a	c	
Marion		70,000a	c	
Mason City	p	16,000	c	2-28
Perry		30,000a	c	
Sioux City		10,000	c	
Spencer	75,000	40,000	c	2-23
Storm Lake	10 Sts.	a	c	
Kentucky—				
Louisville		25,690	c	2-23
Maysville		6,000	c	3—
Louisiana—				
Shreveport	18,500	8,000	c	
Michigan—				
Ann Arbor		15,000a	c	4 or 5
Detroit		10,000	m	
Flint	250,000	125,000	m	
Flint	3,500	1,500	m	
Jackson		19,187a	c	
Minnesota—				
Mankato		10,000	c	4—
Mississippi—				
Vicksburg		9,164a	..	
Missouri—				
Centerville		75,000	c	
Independence		60,000	c	
Kansas City		30,000	..	
Nebraska—				
College View		15,000	c	6—
Hastings		173,900a	c	
Lincoln		10,000	..	3-1
Seward		30,000a	c	4 or 5
University Pl.		some	..	
New Jersey—				
Bayonne		36,000	c	
Dover		20,000	c	5-1
Elizabeth	50,000		c	
Jersey City		8,500	c	
Passaic		35,000	c	
New York—				
Buffalo		270,000	c	
Lockport	1,000		c	
Schenectady		60,000	c	
North Carolina—				
Burlington	50,000	25,000	c	3-9
Gastonia		40,000	c	
Greensboro	30,000	20,000	c	
Wilson		70,000	c	3—
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Conneaut	31,320	15,200	c	
Dayton	35,200	12,790	c	4 and 5
Lakewood		100,000d	..	
Lima		17,400	c	
Middletown		7,335d	c	5 or 6
Urbana		18,000	c	
Oregon—				
Astoria		40,000d	c	5 and 6
Eugene	Some.			
Portland		33,458	c	
Pennsylvania—				
Scranton	67,340	25,847	c	3
South Carolina—				
Sumter		6-7 ml.d	..	
South Dakota—				
Huron		30,000d	..	
Sioux Falls		100,000d	..	
Utah—				
Ogden		24,000	..	
Washington—				
Walla Walla	200,000	100,000d	c	
Wisconsin—				
Beloit		100,000d	..	
Madison		38,600	c	
Manitowoc	25,000	13,000	c	
Marshfield		36,892d	c	
So. Milwaukee		11,500d	c	
CANADA—				
Ontario—				
Hamilton		30,000	..	
Ottawa	250,000	80,000	c	4

ASPHALTIC OR BITUMINOUS CONCRETE OR MACADAM.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Phoenix	200,000a		..	
Arkansas—				
Hot Springs	18,000	23,715	c	1
Jonesboro	200,000	100,000	c	4-15
California—				
Hermosa Beach	p	25,000	c	
Marysville		17,960	c	
Petaluma		10,000	c	4 or 5
Richmond		20,000	c	
Santa Rosa		16,000	c	
Turlock		5,775	c	
Vallejo	p	20,000	c	5-1
Venice		30,000	..	
Connecticut—				
Danbury	7,400	6,700	..	
Danbury	16,200	16,200	..	
East Hartford		15,000	c	
Putnam		3,000	m	
Wethersfield	2,000		m	
Delaware—				
Milford		5,000	m	
Illinois—				
Chicago Hgts.		47,000	c	3—
Elgin		50,690	c	
Freeport	10,000	8,000	c	5—
Hinsdale		5,000	..	5-16
LaGrange		20,000	..	
Marion		10,000	c	5—
Naperville		60,000	c	6-1
Oak Park	533,539	193,500	c	

State and City	Appropriation	Sq. Yds.	Cont.	Date of Letting
Indiana—				
Bluffton		2 mi.	c	3-8
Crown Point	p	10,000	c	
Frankfort		4,600	c	
Gary		10,000	..	
Goshen		36,000	..	
Logansport		17,000a	c	
Marion		10,000	m	
Princeton		12,000	c	
Richmond		1,000	m	
South Bend		140,262a	c	
Wabash		11,000	c	5-1
W. Lafayette		10,000a	c	
Iowa—				
Centerville		30,000a	c	
Greenfield		18,000	c	
Storm Lake	10 Sts.	a	c	
Kansas—				
Great Bend		30,000	..	
Iola		7,000	c	4-—
McPherson		35,000	c	4-1
Osawatomie	4,550	5,000	c	
Pittsburg		29,000	c	
Topeka		65,000	c	2-29
Wellington	87,700	63,120	c	
Kentucky—				
Ft. Thomas		11,000	c	
Maine—				
Lewiston		6,000	m	
Maryland—				
Frederick		13,220	m	
Massachusetts—				
Brookline		50,000	..	
Greenfield		5,000	..	
Lawrence	Some.			
Manchester	29,000		..	
Needham	6,000	10,000	m	
Norwood	16,000	17,000	..	
Revere	20,000	20,000	c	4 to 9
Michigan—				
Battle Creek		50,000	c	
Detroit		10,000	c	
Eaton Rapids	17,000	16,000	c	
Jackson		5,577	c	
Ludington	30,000	20,000	m	
Sault Ste Marie		6,000	m	
Minnesota—				
Mankato		10,000	c	4-—
St. Cloud		17,000a	c	3-7
St. Paul		90,769	..	
Mississippi—				
Starkville		15,960	c	
Missouri—				
Clayton		2mi a	co	
Columbia		677	c	
Columbia		11,679	c	4-15
Kansas City		190,000	c	
Montana—				
Miles City		30,000a	c	
New Jersey—				
Bayonne		5,300	c	
Bloomfield		2,500	c	2-21
Elizabeth	100,000		c	
Irvington		8,000	c	
Passaic		5,000	c	s
Rutherford	13,000	10,535	c	4-—
Westfield		7,500	c	3-20
New Mexico—				
Raton		28,000	..	
New York—				
Dolgeville	Some.			
Geneva		10,000	m	
Gloversville		10,000	c	5-1
Gouverneur	3,000	7,000	m	
Hudson	42,400	26,050	c	
Johnstown	2,000	2,000	m	
Newark		4,000	c	
Plattsburg		5,000	m	
Salamanca		10,000	c	
Utica	144,000d		..	
North Carolina—				
Asheville		15,000	c	4
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Lakewood		100,000d	..	
Lorain		26,000	c	4-15
Norwood		10,000	c	3-—
Oregon—				
The Dalles		4,080	m	
Eugene	Some.			
Klamath Falls		½ mi.	..	
Portland	71,432	39,705	c	
Pennsylvania—				
Carbondale		3,000	c	
Carlisle		10,000d	..	
Freeland	3,000	4,700	m	
Morrisville	201		..	
Norristown		3,000	m	
Northampton	4,235	2,420	c	2-18
Northampton	4,000	3,565	m	
Scranton	2,430	1,620	c	3-—
Waynesboro		15,000	m	
Rhode Island—				
Woonsocket	43,650		m	
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000	..	
Mitchell		27,086	c	2-10
Sioux Falls		100,000d	..	
Yankton		80,000d	..	
Texas—				
McKinney	70,000	46,000	..	3 or 4
Virginia—				
Farmville		2,700	m	
Staunton		8,000	m	
Washington—				
Vancouver	250		m	
Walla Walla	200,000	100,000	c	
West Virginia—				
Charleston	117,647	63,366	c	
Wisconsin—				
Baraboo		8,000	m	
Lake Geneva		2,000	..	
Madison		13,260	c	
Waukesha	15,000	11,000	c	3-30
CANADA—				
Ontario—				
Ottawa		15,000	m	
Stratford		5,000	m	
Stratford		8,000	c	

BITULITHIC.

State and City	Appropriation	Sq. Yds.	Cont.	Date of Letting
Arizona—				
Phoenix		200,000a	..	
California—				
Richmond		10,000	c	
Indiana—				
Goshen		36,000a	..	
South Bend		140,262a	..	
Iowa—				
Centerville		30,000a	..	
Storm Lake	10 Sts	a	c	
Kansas—				
Rosedale		40,000	c	
Kentucky—				
Ludlow		20,000	c	
Massachusetts—				
Brookline		10,000	..	
Lawrence	Some.			
Manchester	10,000		c	
Minnesota—				
Hibbing	15,000	4,500	c	
St. Cloud		36,000a	c	3-7
St. Cloud		17,000a	c	3-7
Virginia		25,000a	c	
Montana—				
Bozeman		20,000	c	
Livingston		5,400	c	2-21
Miles City		30,000a	c	
New York—				
Herkimer	20,000	8,000	c	6-—
Utica	144,000d		..	
North Carolina—				
Wilson		15,000	c	3-—
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Lakewood		100,000d	..	
Oregon—				
Portland	261,599	103,904	c	
Portland	5,041	2,564	gravel	
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000d	..	
Sioux Falls		36,000	c	
Sioux Falls		100,000d	..	
Yankton		80,000d	..	
CANADA—				
Ontario—				
St. Catharines	19,000	7,200	c	

BRICK.

State and City	Appropriation	Sq. Yds.	Cont.	Date of Letting
Colorado—				
Ft. Collins		1,545	c	3-10
Connecticut—				
Bristol	30,000	14,000	c	s
Florida—				
Live Oak		13,000a	c	
Sanford	150,000	80,000	c	
Idaho—				
Blackfoot		50,000a	c	
Illinois—				
Alton	p	75,000	c	4-—
Chicago Hgts.		70,000	c	s
Danville		46,800	c	
E. Moline	35,274	15,683	c	3-—
Elgin		72,158	c	
Galva		15,125	c	
Freefort	74,000	30,000	c	5-—
Lake Forest	50,785	16,700	c	
Lawrenceville		9,000a	..	
Marion		25,000	c	4-—
Marshall		22,416	c	4-1
Mattoon		31,500	c	5-—
Moline	21,381	7,519	c	4-15-30
Murphysboro		12,000	c	
Paris		4,600	c	
Pontiac	14,550	7,350	c	5-1
Rockford		52,000	c	4-—
Shelbyville		2,700	c	
Indiana—				
Bluffton		1 mi.	c	3-8
Brazil	10,400	7,920	c	
Crawfordsville		6,700	c	
Frankfort		9,400	c	
Gary		15,000	..	
Goshen		36,000a	..	
Logansport		17,000a	..	
Noblesville		1,980	..	
Portland		7,500	c	3-6
Richmond		12,000	c	3 or 4
Union City		14,000	c	3-—
Warsaw		12,000	c	
Iowa—				
Anamosa		1 mi.	..	
Burlington		4,500	c	4-1
Centerville		30,000a	c	
Council Bluffs	36,317p	17,294	c	
Clinton		22,000	..	
Davenport		15,000	..	
Ft. Madison		20,920	c	3-1
Manchester—Probably 4 or 5 blocks.				
Missouri Valley	100,000p	42,820	c	1-—
Pella		33,000	c	
Perry		30,000a	c	
Kansas—				
Arkansas City		35,000	c	
Atchison		7,500	c	3-6
Council Grove		19,500	c	
Dodge City		8,500	c	4-—
Fredonia		20,000	c	
Holton		10,000	c	2-21
Hutchison		50,000	c	
Iola		8,000	c	4-—
Lawrence		14,000	..	
Lyons		11,000	c	2-25
Lyons		25,000	c	s
Minneapolis		19,043	c	
Neodesha		30,000	c	s
Ottawa		9,370	c	
Pittsburg		19,000	c	3-1
Topeka		46,000	c	2-29
Kentucky				
Louisville		26,677	c	2 and 3
Louisville		11,100	m	
Maysville		26,000	c	3-—
Louisiana—				
Shreveport	26,500	12,000	c	
Massachusetts—				
Greenfield	3,000	4,000	m	
Michigan—				
Battle Creek		8,000	m	
Flint	20,000	9,000	m	
Holland		2,000	m	
Jackson		19,187a	c	
Jackson		8,151	c	
Minnesota—				
St. Paul		5,572	..	
Virginia—10 blocks of alleys—a.				
Mississippi—				
Vicksburg		9,164a	..	
Missouri—				
Clayton		2mi a	co	
Fulton		3,000	c	
Kansas City		45,000	..	
Lexington		6,000	..	
Sedalia		50,000	c	
Warrensburg		6,000	c	f
6Nebraska—				
Havelock		1 mi.	c	
Lincoln		25,000	c	s
Nebraska City—Some contemplated.				
University Place—Some.				
New Jersey—				
Dover		2,000	..	
Elizabeth	25,000		c	
Ridgewood	35,000	17,000	c	
New York—				
Albion		10,000	..	5-—
Buffalo		50,000	c	
Dolgeville	Some.			
Elmira		18,412	c	2-24
Fulton	20,000	7,200	c	4-1
Hudson	5,000	2,035	m	
Jamestown		50,000	m	
Oneonta		500	m	
Oswego	60,000	24,000	c	5-1
Plattsburg		600	c	
Rensselaer		12,600	..	
Wellsville—Small amount.				
North Carolina—				
Wilson		15,000d	c	
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Bucyrus		100,000	c	
Chillicothe		11,000	c	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Cuyahoga Falls		24,000	c	
Dayton	25,300	115,180	c	4 and 5
Fayette		7,000	c	5-1
Fostoria	24,000	9,000	c	
Franklin		10,000	c	6-1
Lakewood		100,000d	..	
Lancaster		16,800	..	
Lima		80,000	c	
Lorain		8,000	c	4-15
Marietta	28,869	14,913	c	
Middleport		50,416	c	
Middletown		7,335d	c	5 or 6
Newark		25,000	c	4-1
Niles		25,000	c	
Norwood		25,000	c	4-—
Painesville	48,000	20,600	c	
Ravenna		9,000	c	
Steubenville	25,000	12,000	c	6
Toronto		9,087	c	5
Urbana		18,000	c	
Wapakoneta		9,000	c	
W. Carrollton		10,000	c	6-1
Oklahoma—				
Okmulgee		50,000	c	
Oregon—				
Astoria		40,000d	c	5 and 6
Portland	35,450	11,212	c	
Pennsylvania—				
Altoona		11,000	c	7-—
Bloomsburg		12,000	..	
Carbondale		25,000	c	s
Carlisle		8,000	m	
Elwood City		3,500	c	5
Franklin	28,800	13,000	..	
Freeport		7,000	c	6
Irwin		10,000	..	
McKees Rocks—Some.				
Meadville	6,000	4,000	m	
Norristown		13,000	..	4-—
N. Braddock		11,000	..	
N. East		35,000	..	
Oil City		1,800	c	
Portage—Some.				
Punxsutawney		2,500	..	
Scottdale	5,000	3,150	m	
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000d	..	
Texas—				
Longview	6,000	2,500	c	
Virginia—				
Staunton		1,000	m	
West Virginia—				
Charleston	11,901	6,157	c	
Moundsville		9,000	c	9-1
Parkersburg	82,776	37,270	c	3-1
Wisconsin—				
Appleton		10,000	..	3-24
Beloit		100,000d	..	
Chippewa Falls		3,300	c	
Janesville—Some.				
LaCrosse		10,000	c	
Manitowoc	36,000	16,000	c	
Marshfield		30,892d	c	
Racine		54,521	c	
S. Milwaukee		11,500d	c	
CANADA—				
Ontario—				
Hamilton		500	..	
St. Catharines	7,500	2,350	c	

CONCRETE.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Nogales		30,000	m	
Phoenix		200,000a	..	
Arkansas—				
Wynne		17m	..	
California—				
Colusa	17,000	3,000	c	
Redondo Beach		45,200	c	5-1
Richmond		60,000	..	5-—
Colorado—				
Ft. Collins	p	21,000	c	3-10
Longmont	b	16,000	c	6-1
Connecticut—				
Danbury	4,000	4,000	..	
Essex	g	0.25m	..	
Greenwich	100,000	53,000	c	4-—
Manchester		8,880	c	g
New Canaan		9,000	c	s
Southington		20,000a	..	s
S. Norwalk	15,000	12,000	m	
Florida—				
Sanford	5,000	2,500	c	
Georgia—				
Athens	12,000	10,000	m	
Macon		90,000	c	
Illinois—				
Belleville		121,000	c	
Berwyn	27,302	14,820	c	
E. Moline		1,000	..	
Lake Forest	30,672	13,700	c	
Lawrenceville		9,000a	..	
Marion—County will spend $175,000 on concrete roads.				
Oak Park	7,796	4,000	c	
Salem		100 mi.a	..	
Indiana—				
Gary		3,000	..	
Huntington		600	..	4-15
Logansport		17,000a	c	
Muncie		23,862a	..	
Noblesville		12,600	..	
Richmond		10,000	..	3 or 4
Seymour		3 mi.	..	
Tipton—Some.				
Tipton—About 7 miles of county road may be let about middle of summer.				
W. Lafayette		10,000a	c	
Iowa—				
Anamosa		20,000	c	6-1
Burlington		5,100	c	4-1
Cherokee		90,000a	c	
Council Bluffs	37,983p	25,771	c	
Ft. Madison		18,040	c	3-1
Mason City		50,000	c	3-13
Perry		30,000a	c	
Sioux City		250,000	c	4 to 8
Spencer	4,000	3,000	c	2-23
Storm Lake	10 Sts.		a	
Kansas—				
Atchison		6,500	c	3-6
Fredonia		15,000	c	
Lawrence		2,000	c	
Rosedale		10,000	c	
Kentucky—				
Ft. Thomas		20,000	c	
Pikeville—Pike county will vote a $500,000 bond issue May 6, to construct 100 miles of concrete and macadam roads.				
Louisiana—				
Kentwood—Perhaps a little.				
Maryland—				
Frederick		13,220	m	
Michigan—				
Alpena		15,000	m	
Calumet		3,500	c	5-—
Greenville	$5,000		c	
Hastings	$26,916	17,278	m	
Saugatuck—Will pave main portion of village with concrete.				
Sault Ste. Marie		3,000	c	6-—
Minnesota—				
Albert Lea		20,000	c	
Bemidji		15,000	c	5-1
Cloquet		4,000	c	
St. Cloud		17,000a	c	3-7
Stillwater—One block.				
Virginia		25,000a	c	
Virginia—Ten blocks of alleys, a.				
Missouri—				
Clayton	alleys	3,160	c	
Kansas City		275,000	..	
Liberty		15,000	c	
Sedalia		20,000	c	
Montana—				
Miles City		7,000	c	
Nebraska—				
Nebraska City—Some contemplated.				
Red Cloud	2,000	220	c	6-—
New Jersey—				
Crawford	$35,000	18,000	c	3-—
Glen Ridge		2,000	m	s
Rahway		4,800	..	
New York—				
Ellensville	4,000	3,000	c	5
Glens Falls		5,300	c	
North Carolina—				
Asheville		15,000	c	4—
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Chicago Jct.	16,635	12,300	c	2-28
Coshocton		2,000	c	
Dayton	10,800	7,000	c	4 and 5
Delaware		11,000	c	
Fostoria	4,500	2,600	c	
Middletown		34,175	c	5
Oklahoma—				
Bartlesville		17,000	c	4
Oregon—				
Astoria		40,000d	c	5 and 6
Portland	59,629	21,954	c	
Salem		10,280	..	
Pennsylvania—				
Carlisle		2,200	m	
Farrell	40,000		c	
Morrisville	489	388	..	
Northampton	8,000	6,310	c	2-18
Renovo		2,400	..	
Rhode Island—				
Woonsocket	$9,940		c	
South Carolina—				
Sumter		6 or 7 mi.d	..	
South Dakota—				
Huron		30,000d	..	
Lead	$6,673	3,178	c	
Mitchell		4,758	c	2-10
Sioux Falls		3,000	c	
Sioux Falls		100,000	c	
Yankton		80,000	c	4-—
Tennessee—				
Bristol		30,000	m	
Newport	$5,000		..	
Utah—				
Ogden		24,000	c	
Provo—Some.				
Vermont—				
Proctor	$2,000		..	
Randolph	$1,000		m	
Washington—				
Chehalis	$15,000	7,500	m	
West Virginia—				
Parkersburg	$45,006	24,898	c	3-1
Wisconsin—				
Beloit		100,000d	..	
Chippewa Falls		1,500	c	
Janesville—Some d.				
Lake Geneva—Some.				
Madison		6,830	c	
Marshfield		30,892d	c	
Menasha		25,000	..	
Neenah		25,000	..	
S. Milwaukee		11,600d	c	
W. Allis		17,550	c	
Canada—				
Ontario—				
St. Catharines	15,500	8,750	c	

CONCRETE WITH BITUMINOUS TOP.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Phoenix		200,000a	..	
California—				
Antioch		41,500	c	3-—
Hermosa Beach	p	16,000	c	
Hollister		24,195	c	
Oakdale	p	1,005	c	3-—
Pittsburg—Some.				
Placerville		20,249	m	4-—
Placerville		4,533	c	
Richmond		20,000	c	6-—
Santa Ana		7,000	c	
Vallejo	p	20,000	c	4-1
Visalia	p	40,000	c	3-13
Illinois—				
Lake Forest	13,168	5,526	c	
Iowa—				
Washington		5,642	c	
Kansas—				
Abilene	$40,000	25,000	c	
Great Bend	$20,000	56,000	c	
Michigan—				
Sault Ste. Marie		17,360	c	6-—
Minnesota—				
Sauk Center		2,000	c	
Missouri—				
Poplar Bluff		30,000	c	
Sedalia		10,000	c	
Webster Grove		5 mi.	..	
New Jersey—				
Bloomfield		40,000	..	4 or 5
Irvington		8,000	c	3-22
Jersey City		50,000	c	
Newark—10,000 sq. yds. in Milburn twp.				
Ridgewood	$1,000		m	
Weehawk	$77,000	48,000	c	4-1
North Carolina—				
Greensboro	20,000	15,000	m	
Ohio—				
Lima		20,000	c	
Middletown		7,336d	c	5 or 6
Oregon—				
Astoria		40,000d	c	5 and 6
Coquille		2,570	c	
Eugene—Some.				
Portland	20,279	9,745	c	
Pennsylvania—				
Bethlehem		45,000	c	
McKees Rocks		2,500	..	
Norristown		2,500	m	
Tennessee—				
Dyersburg		25,000	c	
Texas—				
Paris	$50,000	20,000	c	
Waxahachie		10,000	c	
Wisconsin—				
Eau Claire	15,000		m	
La Crosse	10,000		..	
Marshfield		30,892d	c	

GRANITE OR SANDSTONE.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Connecticut—				
Danbury	$2,500	2,500	m	
Derby	2,000	860	c	
Willimantic	5,000	1,800	..	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Idaho—				
Blackfoot		50,000a	..	
Kentucky—				
Louisville		4,880	c	2-23
Massachusetts—				
Lawrence—Some.				
Manchester	$4,100	1,250	..	3-6
Norwood	$40,000	12,000	..	
Revere	$6,000	2,000	c	5-1
Minnesota—				
St. Cloud		36,000a	c	3-7
Missouri—				
Kansas City		10,000	..	
New Jersey—				
Bayonne		9,700	c	
Elizabeth	150,000		c	
Jersey City		43,000	c	
New York—				
Albion		5,000	c	5-—
Buffalo		10,000	c	
Plattsburg		1,500	c	
Rensselaer		400	..	
North Carolina—				
Wilson		15,000d	c	
Ohio—				
Dayton	40,000	12,675	c	4 and 5
Norwood		32,000	c	4—
Oregon—				
Portland	32,814	8,355	c	
Pennsylvania—				
Carbondale		2,000	c	s
Gilberton		25,000	m	
McKees Rocks—Small quantity.				
Scranton	19,505	7,232	c	3—
Rhode Island—				
Woonsocket	$163,797		c	
South Dakota—				
Sioux Falls		16,000	c	
Wisconsin—				
Appleton		3,000	..	4-1
Madison		285	c	

GRAVEL STREETS AND ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Nogales		17,000	c	
Arkansas—				
De Queen		23 mi.	..	
Paragould	b	15,000	c	
California—				
Colusa	$2,000	3,000	c	
Redondo Beach		3,111	c	
Colorado—				
Colorado Sp'ngs		100,000	m	
Durango		1 mi.	m	
Ft. Collins	p	25,500	..	
Longmont		5,000	m	
Connecticut—				
Norwalk	$10,000		m	
Indiana—				
Lafayette		12,000	c	4 and 5
Kansas—				
Fredonia		3,000	c	
Weir	$4,000		c	
Louisiana—				
Kentwood—Little but repairs by city.				
Patterson	$900	2,400	m	
Maine—				
Lewiston		5,000	m	
S. Paris—State gravel road work.				
Massachusetts—				
Needham	$3,000		m	
Orange		2mi	..	
Revere	$3,000		..	
Michigan—				
Hastings		2mi	m	
Holland	$5,000	9,433	m	
Traverse City	$3,500		m	
Minnesota—				
Anoka		½mi	..	
Faribault—Several miles.				
Hopkins		1mi	m	
Mankato		15,000	c	4-—
Sank Center		50,000	m	
Mississippi—				
Gulfport	$1,500	1,000	m	
Starkville		21,020	c	
Missouri—				
Pierce City		2,400ft.	..	
Webster Grove		10mi	..	
Nebraska—				
Chadron		10,000	c	5-—
New Jersey—				
Long Branch	$10,000	30,000	m	
Wenonah	18,000	47,000	c	3-15
New York—				
Albion		10,000	..	
Ellenville	1,200		m	
Herkimer	Some		m	
Johnstown	1,000	2,500	m	
Oneonta	500	5,700	m	
North Carolina—				
Goldsboro		10,000	m	
Wilmington	5,000	6,000	m	
North Dakota—				
Minot	33,000	60,000	c	
Ohio—				
Dayton	14,000	27,600	c	4 and 5
Greenville	200		m	
Rhode Island—				
Tiverton	5,000		..	
South Dakota—				
Mitchell		1½mi	c	
Tennessee—				
Paris		10,000	m	
Texas—				
Greenville		3,500	m	
Longview	$12,600	50,000	m	
Orange	$25,000		m	
Sulphur Sp'ngs	$400,000	in Co. Road Dist.		
Waxahachie		18,000	m	
Vermont—				
Middlebury	$1,500		m	
Washington—				
Grand View		3,000	m	
Puyallup	$3,400	5,400	c	3-15
Sunnyside		10,000	c	
Tenino		5,000	m	
Wenatchie	$2,000	6,600	m	
Wyoming—				
Laramie		25,000	m	

MACADAM STREETS AND ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Jacksonville		2mi	c	
Arkansas—				
Mena		50 mi.	co	
California—				
Santa Rosa		10,000	m	
Santa Rosa		4,500	c	
Connecticut—				
Norwalk	$5,000		m	
Willimantic	8,000		..	
Illinois—				
Freeport	22,000	20,000	c	5-—
Rockford		26,000	c	4-—
Salem		100mia		
Indiana—				
Greencastle		30,000	c	
Seymour		3mi	..	
Union City		2,000	c	
Kentucky—				
Pikeville—Pike county will vote May 6 on $500,000 bonds to build 100 miles of macadam and concrete roads.				
Maryland—				
Frederick		6,530	m	
Massachusetts—				
Norwood	$6,000	8,000	..	
Westboro	$4,000		..	
Minnesota—				
Anoka		¾mi	..	
Missouri—				
Clayton		5,000	..	
New York—				
Johnstown	700	1,000	m	
Ohio—				
Greenville	1,000		c	
Oregon—				
Eugene		1,000	c	
Portland	42,229	8,810cy	c	
Pennsylvania—				
Carlisle—Considerable resurfacing.				
Lykens—Some.				
Mt. Joy		1,000	..	
Rhode Island—				
Tiverton	7,000	1mi	..	
South Dakota—				
Lead	3,000	3,000	m	
Vermont—				
Bennington	$5,000		m	
W. Rutland		¾mi	g	

OILED STREETS OR ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Anniston		35,000	m	
California—				
Richmond		20,000	..	
Santa Ana		2m	..	
Sierra Madre	p	6,300f	m	
Visalia		50,000	m	
Colorado—				
Colorado Sp'ngs		10,600	m	
Connecticut—				
Ansonia	$2,000		c	
Danbury		60,000	c	
Norwalk	$10,000		m	
Willimantic	$3,000		..	
Florida—				
Lynn Haven		20,000	..	
Palm Beach		10mi	..	
Illinois—				
Collinsville—A few streets.				
Delavan		1,600	..	
Galva—Main streets and township roads.				
Freeport		2,100	4mi c	
Greenville		9,000 — State and county by contract.		
LaGrange		30,000	..	3-1
Mt. Pulaski—All streets in the city.				
Oak Park		59,000	m	
Polo—Most of the city's streets.				
Salem		12,084	c	
Waukegan		6,127 21,000	c	s
Indiana—				
Bluffton—City streets to extent of 3 tanks of oil.				
Crawfordsville—Some by city.				
Crown Point		66,500	c	3-16
Greencastle		30,000	..	
Huntington		10,000f	m	
Jeffersonville		281,600	m	
Lafayette		182,000	c	4 and 5
Laporte		25,000	..	
Noblesville—9 cent levy to oil all streets by city force.				
Kentucky—				
Carlisle	Some		c	
Frankfort—Will use about 60,000 gal. of oil.				
Louisville		1,000,000	c	
Maine—				
Lewiston—Will be done as needed.				
Paris—1½ miles last year.				
Massachusetts—				
Brookline		40mi	..	
Fairhaven	Some		m	
Greenfield—110,000 gal. asphaltic oil.				
Lawrence—Many streets each year.				
Needham	$3,500	150,000	m	
Norwood	$2,100		..	
Orange—About 35,000 gallons.				
Provincetown	$1,000	4,638	m	
Revere	$8,000		c	
Westboro	$2,000		m	
Michigan—				
Traverse City	$1,000		..	
Minnesota—				
Faribault—Several miles.				
Hopkins		3mi	m	
Mankato		60,000	c	4-—
New Ulm—200 blocks.				
Sank Center—Under consideration.				
Willmar		3mi	m	
Missouri—				
Columbia		8,646	c	
Fulton		30,000	m	
Pierce City—One car of oil.				
Sedalia		20,000	m	
Webster Grove		10mi	..	
Windsor		10,000	m	
New Jersey—				
Bloomfield		80,000 gal	c	2-21
Cliford	1,500	90,000	m	
Glen Ridge		10mi	c	
Irvington		200,000	m	
Lambertville		Some	..	
Passaic		240,000	m	
Plainfield—60 mi. with tar.				
Rahway—20,000 gals. of tarvia or asphalt.				
Rutherford	$6,000	50,000	m-c	4-—
Wenonah	$4,000	40,000	c	4-1
Westfield		275,000	m	
New Mexico—				
Albuquerque oil or tar		20,000	c	6-1
Albuquerque—Also some calcium chloride treatment.				
New York—				
Albion		43,500	m	
Buffalo		184,000	m	
Geneva		60,000	m	
Glens Falls		300,000	c	4-15
Gloversville		25,000	c	
Gouverneur	1,000	60,000	..	
Herkimer	Some		m	
Johnstown	500	10,000	m	
Lackawanna		90,000	m	
Middletown	Some		..	
Oneonta	2,977	99,227	c-m	
Watertown	2,750		m	
Ohio—				
Chillicothe		42,000	m	
Dayton—About 34 miles.				
Norwood		160,000	c	5-—
Oregon				
Eugene		5,000	m	
Pennsylvania—				
Carlisle	150,000l		..	
Lykens	Some		..	
Morrisville	$1,116		..	
Norristown		21,000	m-c	4-—
Renovo		11,000	..	
Rhode Island—				
Woonsocket—100,000 gal. oil applied by city.				

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
South Dakota—				
Aberdeen—Six blocks.				
Tennessee—				
Paris		75,000 gal	..	
Vermont—				
Bennington—About 3 tank cars.				
Middlebury	$750		..	
Proctor		150,000	..	
Virginia—				
Harrisonburg		20,000	..	
Staunton		50,000	m	
Washington—				
Sunnyside		10,000	m	
Wisconsin—				
Antigo		150,000	c	4——
Baraboo		10,000	m	
Chippewa Falls		15mi	..	
Janesville		10 mi.	m	
Lake Geneva		5 or 6mi	..	
Madison		100,000	m	
Manitowoc		20,000	m	
CANADA				
Ontario—				
Hamilton		1,000,000	..	
Stratford		75,000	m	

WOOD BLOCK.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arkansas—				
Hot Springs		4,000	m	
Illinois—				
Granite City		22,360	c	
Pontiac		5,000	c	7-1
Indiana—				
Gary		5,000	..	
Logansport		17,000a	..	
South Bend		140,262a	..	
Iowa—				
Burlington		6,950	c	
Centerville		30,000a	c	
Massachusetts—				
Manchester	$17,400	4,640	..	3-6
Michigan—				
Detroit		40,000	m	
Monroe	$1,200	350	m	
Monroe		450	c	
Minnesota—				
Albert Lea		23,000	c	
St. Cloud		36,000a	c	3-7
St. Paul		90,807	..	
Virginia		25,000a	c	
Missouri—				
Kansas City		40,000	..	
New Jersey—				
Jersey City		4,200	c	
New York—				
Buffalo		1,400	c	
Plattsburg		460	c	
Watertown	31,000	9,500	c	3-17
North Dakota—				
Fargo		90,000d	..	
Minot	80,000	25,000	c	3-20
Ohio—				
Dayton	140,000	35,800	c	4 and 5
Norwood		21,000	c	4—

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Oregon—				
Astoria		40,000d	c	5 and 6
Eugene—Some.				
South Dakota—				
Huron		30,000d	..	
Wisconsin—				
Chippewa Falls		3,500	c	
Madison		5,900	c	
W. Allis		15,450	c	
CANADA—				
Ontario—				
Hamilton		2,000	..	
Ottawa		20,000	c	4

MISCELLANEOUS STREET IMPROVEMENTS.

Alabama—

Dothan—City will grade all streets not now to profile and make sand-clay road surfaces.

Hope—Expect to put in 16,000 sq. yds. of paved streets in 1916.

District of Columbia—

Washington—Appropriations are to be made for year beginning July 1.

Florida—

Delano—Much road building by county, none by city.

Live Oak—9,000 sq. yds. Rocmac put in as a demonstration. May pave 13,000 sq. yds. with Rocmac or brick in 1916.

Palm Beach—Extension of city limits will require much new work.

Sanford—Has appropriation of $10,000 for 8,000 sq. yds. of marl pavement to be done by contract, and 100-ft. boulevard along Lake Monroe. City and county have $500,000 bond issue for road work.

Georgia—

Rome—City commissioners do not make appropriations and plans for work until latter part of April.

Idaho—

Boise—Business men's recommendations to spend $100,000 to $200,000 on paving in 1916 will probably be adopted. County will shortly vote on $200,000 bonds for crushed gravel macadam and some oiled road.

Lewiston—About 4 improvement districts will spend some $75,000, and park improvements will cost about $20,000.

Moscow—Will pave about 25,000 sq. yds. Bids will be received about April 15 for all standard form of paving on concrete base and asphalt or something similar will probably be decided upon.

Illinois—

Effingham—County will construct about 15 miles of dirt road including bridges and culverts; appropriation $8,000.

Mattoon—Will probably build $75,000 worth of pavements in 1916.

Salem—Marion county, Ill., contemlpates bond issue to construct 100 mi. macadam and concrete roads.

Savanna—Will probably do some paving and sewer construction after organization of new council, May 4.

Indiana—

Portland—Nothing new in city. Will be some city streets built by county under 3-mile road law.

Massachusetts—

Manchester—$30,000 for general street work.

Michigan—

Jackson—The total appropriation for asphalt, asphalt concrete and brick pavements is $83,189.61.

Marshall—Some talk of paving.

Mississippi—

Summit—11¼ miles interurban railway.

Nebraska—

Hastings—Bids received March 13 on 173,900 sq. yds. of paving, kind to be selected after bids are opened.

Seward—Will pave 20,000 sq. yds. this summer; choice of material to be made after bids are opened in April or May.

New Jersey—

New Brunswick—$60,000 of paving contracted for; more in prospect.

Plainfield—Will construct considerable macadam and permanent pavements.

Ohio—

Elyria—Will pave 17,100 sq. yds. on five streets; kind not stated.

Oklahoma—

Holdenville—About 19,000 sq. yds. of paving in contemplation; kind not yet decided.

Oregon—

Marshfield—Asphaltic rock, 9,000 yards to be let by contract in April or May.

Pennsylvania—

Norristown—Will lay 5,000 yds. of pavement; kind not given, in addition to amounts given in tables above.

Scottdale—Has appropriated $2,250 to lay 10,000 yds. of crushed slag by day labor.

Steelton—Will do about 20,000 yards of paving if bonds are voted in May.

South Carolina—

Charleston—Has appropriated $80,000 for half the cost of street paving in 1916; schedule for year's work not yet prepared.

South Dakota—

Canton—Will pave several blocks; kind not yet decided.

Madison—Resolutions published for 25,000 sq. yds. of paving and about 10,000 more will follow.

Texas—

Lufkin—Will possibly contract for ½ mi. of pavement. County road district No. 5 has voted $200,000 bond issue for good roads.

Quanah—May pave a few blocks of street in 1916.

Washington—

South Bend—$2,000 for 3,000 lin. ft. of plank street to be let by contract.

CANADA—

Alberta—

Calgary—Following estimates are given for street improvements for 1916: Grading, $3,500; boulevarding, $4,650; paving five streets, $22,413.

SIDEWALK IMPROVEMENTS—1916.

SIDEWALKS.

(Concrete unless otherwise noted.)

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Anniston		5,000	c	s
Jacksonville	$3,000	3,500	c	
Arizona—				
Nogales		8,000	c	
Phoenix		2m	c	
California—				
Los Gatos		6,328	c	
Marysville		6,000	c	
Orange—Some.				
Orland—1,600 s. y. or more.				
Redondo Beach		27,700	c	5-1
Richmond		5m	..	
Santa Rosa		5,000	c	
Santa Rosa		1,000	m	
Visalia	p	11,000	c	4—
Colorado—				
Colorado Spgs.		1,000	c	6—
Durango	p		..	
Ft. Collins	p	8,000f	c	
Ft. Collins	p	1,000fe	c	
Grand Junction	p	3,000	m	
Lendville	2,025	200	c	
Longmont	p	4,000	..	
Longmont	p	2,000e	..	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Connecticut—				
Bristol	p	5,000	c	s
Danbury	Some.			
East Hartford		2,000	c	
Manchester		15,000	c	
Putnam	Some.			
Delaware—				
Milford	Some.			
Florida—				
Sanford	4,500	5,000	c	
Georgia—				
Athens	5,000		m	
Carrollton	Some.			
Macon	Considerable		c	
Idaho—				
Lewiston		15,500	c	
Moscow	Some.			
Illinois—				
Berwyn	51,000	68,000	c	
Carrollton—$3,000 worth of sidewalks probable.				
Delavan		665	m	
Freeport	4,000	2 mi.	c	
Galva	11,000	2,222	c	
Herrin—$25,000 will be let late in the season.				
Mattoon	Some.			

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Moline	28,471	24,500	c	4, 1-15
Mt. Pulaski	Some		m	
Murphysboro		5,000	c	
Pontiac	Some			
Taylorville		5,000 to 10,000		
Indiana—				
Covington		3,000	c	
Crown Point		500	c	
Elwood		5,196	c	3 or 4
Frankfort		4,900	c	
Gary		10,000	c	
Greencastle		44,000	c	
Huntington		1,000	m	
Lafayette		4,000	c	3 to 9
Laporte		556	..	
Marion—Some by property owners.				
Portland		1,000	..	
Union City		7,000	c	3—
Wabash		4,000	c	5-1
Washington		21,000	..	
Iowa—				
Burlington—Several miles by property owners.				
Davenport—8 miles by property owners.				
Sioux City		5,000	c	
Spencer	1,000	10,000	m	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Kansas—				
Arkansas City	.....	1,111	c	.....
Dodge City—Done by property owners.				
Garden City—Done by property owners.				
Hutchinson—2 or 3 miles by contract.				
Osawatomie	.....	540	..	3-9
Rosedale—Considerable.				
Topeka	.....	10,000	..	.....
Kentucky—				
Carlisle—Some by property owners.				
Frankfort	Some.			
Louisville	.....	7,053	c	2-28
Louisiana—				
Kentwood—Very little.				
Maine—				
Lewiston	.....	14,000	m	.....
South Paris	300	.....	..	.....
Massachusetts—				
Brookline	.....	50,000	..	.....
Fairhaven	.....	300	c	.....
Greenfield	.....	5,000	..	.....
Needham	.....	2,000	10,000	c .....
Norwood	.....	5,000	5,000	.. ..
Orange—Small amount.				
Provincetown	2,000	8,000	m	.....
Revere	.....	7,000	5,000	c 3-20
Westboro	.....	5,000	.....	.. ..
Michigan—				
Alpena	.....	3,800	m	.....
Ann Arbor	p	.....	..	.....
Battle Creek	.....	15,000	m	.....
Detroit	.....	10,000	m	.....
Detroit	.....	5,000	c	.....
Eaton Rapids	.....	110	m	.....
Flint	.....	40,000	45,000	m .....
Hastings	.....	2 mi.	m	.....
Holland	.....	3,000	m	.....
Jackson	.....	21,000	7 mi.	.. ..
Ludington	.....	.....	5,000	.. ..
Manistee	.....	400	.....	.. ..
Marshall	.....	p	.....	.. ..
Onaway—30 blocks.				
Sault Ste Marie	.....	5,500	..	.....
Minnesota—				
Albert Lea	.....	6,000	c	.....
Anoka	.....	1,760	c	.....
Bemidji	.....	1,600	c	5-1
Cloquet	.....	½ mi.	c	.....
Hibbing	.....	2,000	c	.....
Hopkins	.....	1 mi.	m	.....
Mankato	.....	6,000	c	4—
Virginia	.....	1,700	c	.....
Willmar	.....	1 mi.	c	5-1
Mississippi—				
Starkville	.....	1,100	m	.....
Summit	.....	3,500	3,267	c 4-4
Missouri—				
Clayton	.....	20,000	c	.....
Columbia	.....	700	c	.....
Independence	.....	6,667	c	.....
Kansas City	.....	26 mi.	..	.....
Sedalia	.....	2 mi.	c	.....
Webster Grove	.....	75 mi.	..	.....
Windsor	.....	5,000	..	.....
Montana—				
Bozeman	.....	1,000	c	4-1
Miles City	.....	2 mi.	c	.....
Nebraska—				
Chadron	.....	900	c	5—
Holdrege	p	.....	..	.....
Lincoln	p	25,000	..	.....
Nebraska City	p	.....	..	.....
Red Cloud	600	150	c	.....
New Jersey—				
Bayonne	.....	333	..	.....
Bayonne	.....	1,000e	..	.....
Bloomfield	.....	1,600	c	3—
Bordentown	p	.....	..	.....
Cranford	.....	500	c	.....
Glen Ridge	Some.			
Irvington	.....	2,200	m	.....
Lambertville	p	500	..	.....
Long Branch	.....	3,500	c	4-1
Newark (Milburn Tp.)		450	..	.....
Newark (S. Orange Tp.)		1,400	..	.....
Orange	.....	3,000	c	.....
Passaic	.....	2,200	c	.....
Plainfield	p	.....	..	.....
Rutherford	2,300	900	c	4—
Westfield	.....	2,500	c	.....
New Mexico—				
Albuquerque—Several thousand lin. ft. 6 ft. wide.				
New York—				
Albion	.....	1,000	m	.....
Buffalo	.....	68,450	c	.....
Dolgeville	.....	1,000 lin. ft.	..	.....
Gouverneur	p	.....	..	.....
Hudson	p	3,000	..	.....
Jamestown	.....	25 mi.	..	.....
Johnstown	3,000	3,000	c	6—
Lockport	.....	1,000	c	.....
Massena	.....	500	..	.....
Norwich	p	.....	..	.....
Oneonta	2,065	12,060	c	6—
Plattsburg	.....	2,000	c	.....
Rensselaer	.....	5,700	..	.....
Salamanca	.....	9,500	c	.....
Schenectady	6,000	.....	c	.....
Utica	Some.			
North Carolina—				
Greensboro	.....	20,000	c	.....
Plymouth	5,000	5,000	m	.....
Rockymount	.....	5,000	m	.....
Wilson	.....	2 mi.	c	.....
North Dakota—				
Bismark	.....	1,500	..	4—
Fargo	.....	10,000	..	.....
Minot	4,000	4,000	c	4-3
Ohio—				
Bucyrus	p	.....	..	.....
Chillicothe	.....	1,800	c	.....
Cuyahoga Falls—Considerable.				
Dayton	.....	3,450	c	.....
Greenville	p	6,000	c	.....
Lakewood	.....	15,000	..	.....
Lorain	.....	5,500e	c	7—
Marietta	p	.....	..	.....
Middleport	.....	9,000e	c	.....
Niles	.....	6,000a	c	.....
Niles	.....	12,000e	c	.....
Niles	.....	12,000	c	.....
Ravenna	Some.			
Steubenville	10,000	8,000	c	5—
Toronto	.....	450	..	.....
Wapakoneta	.....	300	c	.....
Oklahoma—				
Bartlesville	.....	4,100	c	4—
Holdenville	.....	2 mi.	..	.....
Oregon—				
Astoria	.....	14,500	c	4 to 6
Coquille	.....	8,000	c	.....
The Dalles	.....	3,385	c	.....
Eugene	.....	12,000	c	.....
Marshfield	.....	3,600	c	4 or 5
Portland	.....	70,400	c	.....
Pennsylvania—				
Blossburg	Some.			
Carbondale	.....	42,000e	c	.....
Carlisle	p	4,000	..	.....
Farrell	.....	600e	..	.....
Freeland	p	5,000	..	.....
Gilberton	.....	1,800	m	.....
Lansford	.....	3,240	1,800	c .....
Lykens	p	1,500	..	.....
McKees Rocks	p	2,000	..	.....
Morrisville	208	.....	..	.....
Norristown	p	.....	..	.....
N. Braddock	.....	177	c	3 or 4
Oil City	.....	2,000	..	.....
South Carolina—				
Columbia	12,000	.....	c	.....
Sumter	.....	12 mi.	c	3-1
South Dakota—				
Aberdeen	.....	1,500	..	.....
Lead	11,088	4,928	c	.....
Mitchell	.....	4,000	c	.....
Sioux Falls	.....	6,500	c	.....
Yankton	.....	1,100	..	.....
Tennessee—				
Franklin	.....	5,000	c	s
Newport	.....	5,000	.....	.. ..
Paris	.....	1,000	c	.....
Texas—				
Ft. Worth—Considerable, p.				
Greenville	.....	750	2,500	m .....
Paris	p	.....	..	.....
Quanah	p	.....	..	.....
Sulphur Spgs.	5,000	.....	c	.....
Waxahachie	.....	2 mi.	c	.....
Utah—				
Ogden	.....	40,000	c	.....
Provo	.....	14,000	c	.....
Vermont—				
Bennington	.....	5,000	.....	c 4-1
Middleburg	.....	1,000	.....	m .....
Randolph	.....	1,000	.....	m .....
West Rutland—Some.				
Virginia—				
Harrisonburg	.....	5,000	m	.....
Staunton	.....	4,000	m	.....
Washington—				
Puyallup	p	2 mi.	..	.....
Tenino	.....	5,000	..	.....
West Virginia—				
Moundsville	p	10,000	c	4—
Wisconsin—				
Antigo	p	.....	..	.....
Ashland	.....	4,000	c	5 or 6
Janesville	.....	1 mi.	..	.....
Lake Geneva	.....	1,000	m	.....
Madison	.....	25,000	c	.....
Marshfield	.....	333	..	.....
Wyoming—				
Cheyenne	p	1,000	c	.....
CANADA—				
Ontario—				
Hamilton	.....	10,000	m	.....
Ottawa	.....	75,000	5 mi.	m .....
St. Catharines	.....	8,000	.....	c .....
Stratford	.....	.....	10,500	m .....

CURB AND GUTTER CONSTRUCTION—1916.

CURB AND GUTTER.

(Concrete combined curb and gutter unless otherwise noted.)

State and City	Appropriation	Lin. Ft.	Cy. or Cont.	Date of Letting
Arkansas—				
Jonesboro	100,000	200,000	c	4-15
Paragould	.....	8,000	..	.....
Arizona—				
Phoenix	.....	88,000	c	.....
Phocnix	.....	7,000d	..	.....
California—				
Antioch	.....	17,500	c	3—
Colusa	1,600	3,200d	..	.....
Hollister	.....	10,556	..	.....
Los Gatos	.....	15,500d	c	.....
Orange	Some.			
Orland—2,000 ft. or more.				
Petaluma	.....	6,000d	c	.....
Pittsburg	Some.			
Redondo Beach	.....	13,800d	c	5-1
Richmond	.....	5 mi.	..	.....
Santa Ana	Some, d.			
Santa Rosa	.....	1,000	m	.....
Santa Rosa	.....	7,000	c	.....
Turlock	.....	4,800d	..	.....
Venice	.....	4,000d	..	.....
Visalia	p	5,000	..	3-13
Colorado—				
Colorado Spgs.	.....	2,000	c	6—
Colorado Spgs.	.....	1,500d	c	6—
Durango	Some, d.			
Ft. Collins	p	6,680	c	.....
Ft. Collins	p	3,000d	c	.....
Longmont	b	6,000d	c	6-1
Connecticut—				
Bristol	.....	10,000d	c	s
Danbury	Some, d.			
E. Hartford	.....	2,500d	c	.....
Manchester	.....	22,500h	..	.....
New Canaan	.....	3,000d	c	s
Delaware—				
Milford	Some.			
Florida—				
St. Augustine	840	2,800	m	.....
Sanford	2,000	6,000	c	.....
Georgia—				
Macon—Considerable grante curb to be put in by city.				
Idaho—				
Blackfoot	.....	5,000d	c	.....
Lewiston	.....	2,700d	c	.....
Lewiston	.....	4,000	c	.....
Moscow	Some.			
Illinois—				
Alton	.....	40,000d	..	.....
Alton	.....	6,120	..	.....
Belleville	.....	55,500d	c	.....
Berwyn	27,000	45,000	c	.....
Chicago Hgts.	.....	32,000	c	3—
Chicago Hgts.	.....	37,000d	c	s
Danville	.....	15,000h	c	.....
Delavan	.....	200d	m	.....
E. Moline	5,107	8,963d	..	.....
Elgin	.....	44,071	..	.....
Elgin	.....	8,249d	..	.....
Freeport	20,000	40,200	c	.....
Galva	.....	6,000	..	.....
Granite City	.....	9,950	c	.....
Lake Forest	.....	20,526d	c	.....
Lawrenceville	.....	7,000	..	.....
Marshall	.....	9,822	c	.....
Mattoon	.....	21,250	c	5—
Mendota	.....	112,000d	c	4—
Moline	.....	2,000d	..	.....
Moline	.....	31,000	..	.....
Mt. Pulaski	Some.		m	.....
Murphysboro	.....	5,000	..	.....
Murphysboro	.....	3,000d	..	.....
Naperville	.....	35,500	c	6-1
Oak Park	.....	126,055	c	.....

State and City	Appropriation	Lin. Ft.	Cy. or Cont.	Date of Letting
Pontiac	4,840	8,800	c	7-1
Pontiac	110	270d	c	5-1
Rockford		44,000	c	4—
Shelbyville		3,000d	..	
Indiana—				
Frankfort		8,820d	c	
Gary		8,000d	c	
Gary		5,000	c	
Goshen		4,600d	c	3-6
Goshen		15,000	c	3-6
Greencastle		10,560	c	
Greencastle		10,560d	c	
Lafayette		10,000	c	3 to 9
Laporte		600d	..	
Laporte		4,500	..	
Logansport		5,000	c	3-14
Muncie		1,982	..	
Portland		6,000	c	3-6
Richmond		5,000	c	
Union City		8,000d	c	3-—
Union City		4,000	c	3-—
Warsaw		8,000	..	
Washington		2,100	..	
Iowa—				
Anamosa		6,000	..	
Atlantic		15,000d	c	6-1
Burlington		4,100d	c	3-1
Cherokee		21,000	c	2-25
Council Bluffs	4,316	7,194	c	
Clinton		6,121	..	
Creston		45,000	c	
Forest City		18,000	..	
Ft. Madison		14,265	c	3-1
Greenfield		18,000	..	
Manchester		12,000	c	
Marion		20,000	..	
Mason City		19 mi.d	c	3-13
Pella		164,000	p	
Sioux City		10,000d	c	
Spencer	8,500	27,000	c	2-23
Washington		1,600	c	
Kansas—				
Abilene	5,000	10,000	c	
Arkansas City		7,000	c	
Council Grove		6,000	..	
Dodge City		7,500d	..	
Fredonia		25,000	c	
Great Bend		15,000	..	
Hutchinson—2 or 3 miles by contract.				
Iola		18,000d	c	
Lawrence		6,000	..	
Lyons		3,000d	..	
McPherson		25,000	c	4-1
Osawatomie	1,800	3,500	c	
Ottawa		7,000	c	
Pittsburg		7,800	c	3-1
Rosedale		15,000	c	
Topeka		57,000	..	2-29
Wellington	4,066	23,550d	c	
Wellington	15,870	34,560	c	
Kentucky—				
Ft. Thomas		20,000	c	3-4
Frankfort	Some.			
Maysville		15,000d	c	3-6
Louisville		24,423h	c	3-3
Louisiana—				
Kentwood—Very little.				
Shreveport	7,500	10,500h	c	
Maryland—				
Cambridge—$50,000 loan to curb and gutter streets is asked for from legislature, election to be in July.				
Frederick		1,670	..	
Massachusetts—				
Brookline		3,000h	..	
Greenfield		1,000h	..	
Manchester	1,200	1,000h	c	
Michigan—				
Alpena		5,000d	m	
Ann Arbor	p		..	
Battle Creek		25,000	m	
Detroit		50,000d	m	
Calumet		1,500	c	
Eaton Rapids		4,800	..	
Greenville		1,500	c	
Hastings	3,412	11,473	m	
Holland	8,500	8,500	..	4-1
Jackson		1,512h	..	
Jackson		18,871	..	
Manistee	2,000	4,000	c	
Monroe		1,800	m	
Onaway		1,000d	.	
Sault Ste Marie		2,000	..	
Traverse City		8,000	m	
Minnesota—				
Albert Lea		4,000	c	
Anoka		4,000	c	
Bemidji		3,000d	c	5-1
Cloquet	Some.			
Faribault		10,000d	c	s
Hopkins		5,000d	..	
Mankato		5,000	c	
St. Paul	26,000d			
Mississippi—				
Starkville		5,315d	c	
Starkville		5,315	c	
Missouri—				
Clayton		3,000	..	
Columbia		10,776	c	4-15
Fulton		1,400d	c	
Independence		20,000d	..	
Kansas City		22 mi.d	..	
Kansas City		4 mi.	..	
Lexington		4,000d	..	
Pierce City		400	..	
Poplar Bluff		8,000	c	
Sedalia		10,560	c	
Warrensburg		2,500d	c	
Webster Grove		60 mi.d	..	
Webster Grove		10 mi.	..	
Montana—				
Bozeman		2,000h	c	4-1
Miles City		2 mi.d	..	
Nebraska—				
Alliance		5,000	c	5-1
Chadron		2,000d	c	5-—
College View		2,800d	..	
Holdredge	p		..	
Lincoln		50,000d	c	
Nebraska City—Some contemplated.				
Seward		8,000d	..	4-—
New Jersey—				
Bayonne		2,300	..	
Bayonne		12,000h	..	
Bloomfield		20,000h	..	3 and 4
Bloomfield		40,000	..	4—
Bordentown	p		..	
Cranford		1,900	..	
Long Branch		12,000d	c	4-1
Irvington		6,800h	m	
Lambertville—Very little.				
Long Branch		12,000d	c	4-1
Newark (Milburn Tp.)—10,000 sq. yds. of cobble gutter under county engineer.				
New Brunskick		4,220	..	
Passaic		4,000	c	
Plainfield	p		..	
Rahway		5,000	c	
Ridgewood	7,400	10,000	c	
Rutherford	1,400	2,000	c	4-—
Wenonah	1,200	1,500	co	4-15
Westfield		1,600	..	3-20
New Mexico—				
Albuquerque		36,000	..	
New York—				
Albion		150,000h	state	5—
Dolgeville	Some.			
Ellenville	p	1,500	c	5—
Elmira		5,700d	c	
Elmira		1,200h	c	
Gouverneur	p		..	
Herkimer		1,400	c	6—
Herkimer		2,400h	c	6—
Hudson		10,000d	c	
Jamestown		20,000	..	
Lockport		1,000d	c	
Norwich	p		..	
Ogdensburg		500d	..	
Rensselaer		10,870d	..	
Schenectady		10,000	..	
Schenectady		35,000h	..	
Watertown		5,000	c	
North Carolina—				
Asheville		5,000	c	
Burlington		7,400	..	
Goldsboro		10,000h	m	
Rocky Mount		2,000d	m	
Rocky Mount		1,000	m	
Wilson		10,000	c	
North Dakota—				
Bismark		6,000d	..	6—
Bismark		3,000	..	6—
Minot	4,506	9,012d	c	
Minot	16,000	32,000	c	10-4
Ohio—				
Chicago Jc	3,655	6,740h	..	
Chicago Jc	4,219	7,691	c	
Chillicothe		3,200d	c	
Chillicothe		3,220	..	
Coshocton		1,200d	..	
Cuyahoga Falls		15,250h	c	
Dayton		27,837d	c	
Dayton		16,000	c	
Fayette		3,300	c	5-1
Fostoria	2,600	5,218	c	
Greenville		6,000d	c	
Greenville	p	10,000	c	
Lima		5,000d	c	
Lima		20,000	c	
Lorain		20,000h	c	4-15
Marietta		10,628d	c	
Middleport		26,700d	..	
Ravenna		7,000d	c	
Steubenville	1,200	4,000d	..	
Steubenville	4,000	8,000	..	
Toronto		8,778	c	5—
Urbana		4,500h	c	
Urbana		6,000	c	
Oklahoma—				
Bartlesville		14,000	c	4—
Holdenville		5,500	..	
Okmulgee		25,000	c	
Oregon—				
Astoria		8,000d	c	4 to 6
Coquille		2,800	c	
Eugene		15,000	c	
Marshfield		7,000d	c	4 or 5
Portland		105,600d	..	
Salem		3,824d	..	
Pennsylvania—				
Carbondale		35,000h	c	
Carlisle	p	5,000d	..	
Elwood City		1,600	c	
Farrell		1,500	..	
Freeland	p	2,400	..	
Freeport		5,000	c	6—
Gilberton		2,000	m	
Lansford	1,600	2,000	c	
Lykens	p	2,000d	..	
Meadville		40,000	..	
Moorisville	208		..	
Norristown	p		..	
Northampton		4,564d	c	
Northampton		1,500	c	
N. Braddock		10,000	..	
Oil City		1,800	..	
Renovo		1,600d	..	
Rhode Island—				
Woonsocket	15,000	15,000h	c	
South Carolina—				
Columbia	12,000		c	
Sumter		12 mi.	c	3-1
South Dakota—				
Aberdeen		1,000d	..	
Lead	Some.			
Madison		10,000	..	
Mitchell		14,846	c	
Sioux Falls		3,000d	c	
Sioux Falls		18,000	c	
Yankton		132,000	c	4—
Tennessee—				
Bristol		8,500	..	
Dyersburg	Some.			
Dyersburg		10,000	c	
Franklin		1,200	c	s
Texas—				
Fort Worth—Considerable. p.				
McKinney	4,500	10,000	c	
Paris		10,000	c	8—
Quanah	p		..	
Waxahachie		1.6 mi.d	c	
Utah—				
Ogden		20,000	c	
Virginia—				
Harrisonburg		3,500	m	
Staunton		2,000d	m	
Staunton		2,000	m	
Washington—				
Walla Walla		10,000d	c	3-15
Walla Walla		50,000	c	3-15
West Virginia—				
Charleston	23,850	42,982	c	
Moundsville		4,200	c	9-1
Wisconsin—				
Baraboo		5,000	..	
Beloit		56,000	c	3—
Chippewa Falls		2½ mi.	..	
Delavan		5,000	..	
Janesville		2,800	..	
La Crosse		3,000	..	
Lake Geneva		4,000	..	
Madison		40,000	c	
Manitowoc		50,000	m	
Marshfield		19,729	c	
Racine		25,073	c	
S. Milwaukee		2,000	c	
Waukesha		7,350	c	3-30
Wyoming—				
Cheyenne		8,000	c	
Laramie		8,000d	..	
CANADA—				
Ontario—				
Hamilton		10,000d	m	
Stratford		10,000d	c	
Stratford		2,000	c	

SEWERS AND SEWAGE DISPOSAL—1916.

SEWERS AND SEWAGE DISPOSAL.

(Vitrified pipe sewers unless otherwise noted.)

State and City	Appropriation	Length Ft.	Size In.	Cy. or Contract
Alabama—				
Anniston		9,500	8	c
Dothan—Extensions in contemplation, also disposal plant, probably not built this year.				
Arizona—				
Nogales—Sewage disposal plant proposed.				
Phoenix		10,000	8, 6	..
Phoenix		15,000j	12, 18	..
Arkansas—				
Hot Springs	8,000	10,000	8, 6	..
California—				
Hermosa Beach		8,300	8, 6	c
Hermosa Beach—Sewage disposal plant contemplated.				
Long Beach—Dozen lateral districts to build shortly.				
Los Gatos		3,658	6	c
Petaluma		1,000	8, 6	c
Petaluma	50,000	2,500		c
Redondo Beach	5,000	5,000	8	m
Richmond		75,000	6 to 24	c
Richmond		10,000	3 to 4x6	..
Richmond—Company proposes to put in model sewage disposal plant.				
Santa Rosa		3,000		m
Sierra Madre—Sewers and disposal plant for a small district.				
Turlock		1,300		c
Venice		8,000i	48	..
Visalia		33,000	6, 8, 10	..
Visalia		14,000i	30	..
Visalia		1,000j	30	..
Visalia—Sewage disposal plant considered.				
Colorado—				
Colorado Spgs.		1,500		m
Ft. Collins	p	900	15, 18	..
Longmont		4,000j	12 to 24	m
Connecticut—				
Ansonia	2,500	1,100		m
Bristol	p	1,000	8	m
Danbury	10,000			..
Greenwich		15,000		..
Greenwich—Sewage disposal plant proposed; no appropriation yet.				
Manchester		4,035	10 to 33	m
Norwalk	5,000		10, 12	m
Putnam—Small amount.				
Southington		20,000k		..
Willimantic	8,000		8, 10	..
District of Columbia—				
Washington	180,000	80,000		cm
Washington	225,000	20,000j		cm
Florida—				
Palm Beach	14,000	15,000	18, 24	c
St. Augustine		1,400	18	m
St. Augustine		2,200	15	m
St. Augustine		2,700	12	m
St. Augustine		1,300	10	m
St. Augustine		1,000	8	m
Sanford	3,000	1,800	16, 18	c
Sanford	800	500	12	c
Georgia—				
Cedartown		1,740	8	m
Macon		1,200v	72 to 120	c
Macon		1,200j	72 to 120	c
Macon—Much pipe sewer also.				
Idaho—				
Blackfoot		5,000	10	..
Blackfoot		2,000	8	..
Lewiston		4,000	c	..
Moscow	Some.			
Illinois—				
Alton		40,600	10 to 30	..
Alton		6,155v	33 to 66	..
Belleville		6,000		..
Berwyn	20,000	20,000	12	c
Berwyn	13,500	9,000	over 12	c
Berwyn—Has $4,000 appropriation for disposal plant.				
Cowden		3,000		..
Danville		10,000	8 to 24	c
E. Moline	3,760	1,700	8	c
Elgin		34,607	6 to 36	c
Elmhurst—$33,000 sewage disposal plant publicly let in fall.				
Fairbury		2,200	10 to 14	..
Galva		2,500j		..
Granite City—Outlet sewer to cost $410,000 projected. Assessment roll in court for confirmation. About 5 miles of concrete sewer 4 ft. 6 in. to 9 ft.				
Madison	155,000	35,000		c
Marshall		5,924	8 to 15	c
Moline	12,000	1,500	48	c
Murphysboro		26,000	8 to 18	..
Naperville		330	20	c
Naperville		924	18	c
Naperville		2,516	15	c
Naperville		2,912	12	c
Naperville		3,412	10	c
Naperville		5,200	8	c
Naperville		5,000	4	c
Oak Park	27,403	15,647	9 to 24	c
Oak Park		130i	30	c
Rockford		5,000	9 to 18	c
Sandwich—Storm sewer contemplated.				
Savanna—Will do some sewer construction after organization of council, May 4.				
Taylorville		16,000		c
Taylorville		6,000v		c
W. Frankfort			6 to 15	..
Indiana—				
Anderson		3 mi.	8 to 12	c
Brazil		2,000	8	c
Butler	Some.			
Covington		1,500	12 to 30	c
Covington		210v	30	..
Crawfordsville	311	363	8	c
Crawfordsville		1,600	15	c
Crawfordsville		900	18	c
Crown Point		5,000v		..
Fairmount—Sewer system under consideration.				
Frankfort		1,370	10, 12	c
Frankfort		3,210	15-24	c
Frankfort—About 2 miles later in the year.				
Gary		10,000	12	c
Gary		4,000	15	c
Gary		2,550	18	c
Huntington		400		c
Lafayette		14,341	8 to 22	c
Lafayette		11,214x	27 to 36	..
Logansport		51,000		c
Logansport		4,000v		c
Logansport		4,000j		c
Marion		1,550	10	c
Marion		2,500	8, 10	c
Muncie		966	10	..
Princeton		20,000		..
Princeton—Small septic tank costing $2,000.				
Union City		1,000	12	..
Wabash		5,000	8, 10, 12	c
Warsaw		2,500	10, 12	..
Iowa—				
Burlington		2 mi.		..
Burlington		1,000v		..
Burlington		1,000j		..
Centerville		4 mi.	6 to 12	..
Cherokee		3,000	6, 8	..
Council Bluffs. $3,011	92,314			c
Davenport—Large amount in next three years.				
Ft. Madison		4,430	12, 15	c
Marshalltown — Some sanitary and storm sewers.				
Mason City—1,000,000-gal. disposal plant. Bond issue, $140,000.				
Pella	9,217	15,000	8 to 10	c
Sioux City		25,000	8	c
Sioux City		3,000j	42	c
Spencer	2,200	2,200	8	m
Kansas—				
Abilene	12,000	3,500j	36	c
Cherryvale—Considerable sanitary sewer work under way.				
Dodge City—One new district to be sewered.				
Garden City—Sewer system in contemplation.				
Holton		500	12 to 24	..
Holton—Reconstruction of disposal plant.				
Hutchinson		2 mi.j		..
Iola		6,500	7,035	8	c
Lawrence		6,500	2,700	30	c
Lawrence		1,500	6,000	ditch	c
Lowrence		2,500	550j		..
McPherson—Some storm sewers and enlargement, and reconstruction of disposal plant.				
Neodesha			500j	36	c
Neodesha—$30,000 Imhoff tank and sprinkling filter plant will be let this spring.				
Ottawa		4,625	8, 12	c
Ottawa		500j	30	m
Rosedale		20,000	8 to 15	c
Rosedale		3,600j	36	..
Topeka		4,800v	36 to 72	c
Wellington	7,571	11,630	10 to 24	c
Wellington		15,800	8 to 15	c
Wellington	10,835	2,920v	30 to 42	c
Kentucky—				
Ft. Thomas		1,400	8	c
Frankfort	Some.			
Louisville		65,000		..
Maysville			2,000	12	c
Owensboro—Bids received about April 15 on $225,000 sewer system, about 2 miles, 6 to 8-foot mains and many laterals.				
W. Covington		1,500	12 to 24	c
Louisiana—				
Kentwood—Very little.				
Shreveport	3,000	3,000	8, 10	..
Shreveport—27 miles of sewer extensions and a disposal plant in contemplation, and engineer making plans.				
Maine—				
Lewiston		5,300		m
Van Buren		800	10	m
Maryland—				
Frederick		810	4 to 12	..
Frederick		1,685x	36, 42	..
Massachusetts—				
Brookline		16,000	8-15	..
Brookline		1,600j		..
Farhaven		400	6, 8	..
Lenox—Has voted $20,000 for about 8,780 ft. of 8, 10 and 12-inch sewer and pump and force main to lift sewage to present disposal plant.				
Manchester	500	300	6	c
Norwood	5,200	3,500	8	..
Revere	20,000			mc
Winchendon	15,000	2 mi.		..
Michigan—				
Alpena	Some.			
Ann Arbor	11,000	13,000	8, 10	c
Ann Arbor	11,500	1,500x	30, 36	c
Ann Arbor	15,000	for storm sewers.		
Ann Arbor	5,600	1,500j	72	c
Battle Creek		24,000	8 to 48	m
Battle Creek		2,000x	30, 36	m
Battle Creek		2,500j	36 to 48	m
Detroit		1½ mi.		..
Calumet		½ mi.	36	..
Eaton Rapids		600		..
Flint	125,000	100,000		..
Flint	125,000	18,000x		..
Hastings		5,000		m
Holland—2,500 ft. 5-ft. concrete arch.				
Holland		5,000	8 to 24	m
Jackson	20,000	not decided.		
Ludington	3,000	3,000		..
Marshall	Some.			
Menominee		4,500	1,300	24	c
Saugatuck—Will construct main sanitary sewer.				
Sault Ste Marie		4,000	9, 12, 18	..
Minnesota—				
Albert Lea		6,400	6, 8, 10	c
Anoka—Sewage disposal plant and mains.				
Bemidji		2,200	12, 15	..
Faribault		2,500	8	c
Hibbing		3,000	c	..
Hopkins—Sewer system, Imhoff tank and chlorine and filtration.				
Mankato		2,000	8, 12	..
New Ulm—Little sewer work.				
St. Paul—$781,641 contracts let.				
Virginia	Some.			
Mississippi—				
Starkville		1,690	12 to 24	..
Starkville—Sewage disposal plant.				
Summit—Will build sewer system to cost $55,000 to $80,000 and disposal plant to cost $20,000.				
Vicksburg		3,827	15 to 36	..
Missouri—				
Clayton		20,000	8 to 30	c
Clayton		500i	36	c
Independence		2,500	8	..
Kansas City—Will receive bids on 20 miles of sewers, vitrified pipe or concrete up to 30-in., concrete, reinforced concrete pipe, reinforced monolithic concrete or brick over 30-in. diameter, the lowest priced material receiving the contract. Bond issue of $450,000 available for disposal plant but plans not yet drawn.				
Liberty	20,000	17,000	18	m
Poplar Bluff		4 mi.xa	24 to 72	..
Poplar Bluff		4 mi.ja	24 to 72	..
Sedalia		3 mi.	8 to 15	c
Webster Grove—Four septic tanks.				
Montana—				
Bozeman—$200,000 water and sewer bonds to be voted on shortly.				
Livingston		7,082	8 to 12	c
Miles City		1 mi.	6, 8	c
Nebraska—				
Gering	11,500	14,910	8 to 12	..
Lincoln		35,000	8 to 21	c
New Jersey—				
Bayonne		400		..
Bloomfield		2,900	15 to 36	c
Bloomfield		2,000	36 to 42	..
Elizabeth		7,000	5,000	..
Glen Ridge	Some.			
Irvington		5,000		m
Irvington		3,000j	84, 96	m
Jersey City		1.100i	30	..
Newark (S. Orange Tp.)—3,000 ft. of tile sewer.				

State and City	Appro-priation	Length Ft.	Size In.	Cy. or Contract
Newark (Millburn Tp.)—4,000 ft. of tile sewer and 7,000 ft. of concrete sewer and disposal plant, all under county engineer.				
New Brunswick		5,000	12 to 20	..
Passaic		16,800	8 to 18	..
Plainfield		5 mi.	8 to 18	..
Rahway—Some 8 to 12 in. by contract.				
Rahway		4,000	2,000	8 c
Rahway—Disposal plant.				
Rutherford		7,125	5,280	8 c
Summit—Some sewers and disposal plant.				
Westfield		13,200	8 to 30	c
New Mexico—				
Albuquerque—Storm sewers for all new paving.				
New York—				
Buffalo		11 mi.	10 to 24	c
Buffalo		½ mi.x	36	c
Buffalo		½ mi.j	27 to 48	c
Catskill—State Board of Health requires sewer system.				
Dolgeville		700		..
Elmira		13,800	10, 12	c
Geneva		3,000		m
Gloversville		4,090	12 to 20	..
Gouverneur		1,000		m
Herkimer		1 mi.	8, 10	m
Hornell		5,000	1,480	24 c
Jamestown		5 mi.	8	..
Johnstown		2,000	2,000	8 m
Lackawanna		2,700	8	c
Lockport		1,500	10	..
Norwich—Some.				
Oneonta—Sewage disposal plant.				
Oswego	35,000	5,600	8 to 36	..
Schenectady		1,000	8 to 12	..
Utica		2 mi.		..
Watertown		3,000	10, 12	c
North Carolina—				
Asheville		10,000		..
Goldsboro		5,000	6	m
Greensboro	25,000	50,000		..
Plymouth		10,000		..
Rocky Mount		1,000		m
North Dakota—				
Fargo		16,000		..
Fargo—Some segment block.				
Minot	47,140	17,559	12 to36	5-15
Minot—$70,000 for two Imhoff tanks and four contact beds.				
Ohio—				
Bucyrus		4,000		c
Chardon		6,000	6,640	6, 8 c
Chicago Jc.	26,732	13,570j		c
Chicago Jc.—Sewage disposal plans on file.				
Chillicothe		2,980	8 to 12	..
Chillicothe		1,370j	36, 40	..
Cuyahoga F'lls.	100,000	52,000	6 to 24	c
Cuyahoga F'lls.		1,500	cast iron 12-in. pipe.	
Dayton		60,875	5 to 24	c
Dayton	250,000	60,000j		4-1
E. Palestine	55,000	11 mi.	6 to 12	c
E. Palestine—Separate sewer system for whole town.				
E. Palestine—$21,000 for Imhoff tanks and electrolytic treatment.				
Fostoria		2,000		c ..
Greenville		15,388	12 to 24	c
Lakewood		20,000	8 to 30	c
Lakewood		2,000x	30 to 54	..
Lakewood		2,000j	42	c
Lakewood		6,000j		c
Lakewood—$200,000 for Imhoff tanks and outlet.				
Lancaster		26,172	6 to 54	c
Lancaster—Alternate bids on sewers over 24-in. for vitrified pipe, reinforced concrete, brick and segment block.				
Lima		6,000	6 to 24	c
Lorain		1,500		c
Lorain	x or i	1,500	60	c
Mansfield		6,000	8	c
Mansfield—Sewage disposal plant.				
Middletown		1,000		4, 5
Newcomerstown		36,000	8 to 18	5-1
Niles		7,000		c
Niles		500x		c
Norwood		10,000	15 to 30	c
Norwood		3,000x		36-60
Painesville	35,000	16,000	8 to 20	c
Ravenna		1,400	24 to 36	c
Urbana		8,000	12 to 18	..
Urbana		1,000j	36, 42	..
Wapakoneta	7,996	7,200	8, 12	c
Wapakoneta		600j	48	..
Oklahoma—				
Bartlesville—$6,000 for disposal plant.				
Enid		80,000		c ..
Holdenville		2,000		8 ..
Mangum		300		8 c
Oregon—				
Astoria		10,000	8 to 30	..
The Dalles		1,420	8	c
Eugene		5,000j	8 to 30	..
Marshfield		3,000	6, 8	c
Pendleton—Septic tank possible.				
Portland	120,000	90,000		c
Salem		1,500	8	m
Pennsylvania—				
Altoona—Disyosal plant in contemplation.				
Avoca		1,000		c
Blossburg		1,200	18	..
Carbondale		5,000	6-12	c
Carlisle		1 mi.		..
Elwood City		2,000		c
Farrell		600		..
Freeland	3,600	2,600	12	m
Freeport		2,500	10	c
Gilberton		2,000x	60	m
Lansford	1,166	1,242	8	c
Lykens		½ mi.		..
McKees Rocks		600	12, 15	m
Meadville	12,000	6,745		m
Meadville	3,000	600x		m
Miners Mills	17,500	17,000		c 3-15
Montoursville		1,000	12	c
Norristown—Several sanitary sewers to be let later in summer.				
N. Braddock		3,000		..
N. Braddock—Perhaps a 5-ft. storm sewer.				
Northeast		2,000	800	24 m
Oil City		5,000	6 to 10	..
Portage—Sanitary sewers.				
Punxsutawney		1 mi.	8 to 18	c
Ridgway		1,400	8, 12	m
Scottdale		3,430	1,572	12, 24 m
Rhode Island—				
Woonsocket	41,000	1 mi.	8 to 18	c
South Carolina—				
Columbia	150,000		8 to 18	c
South Dakota—				
Aberdeen		2,600	15	..
Mitchell		3,165	8, 10	c
Sioux Falls		15,000	8 to 12	..
Yankton		10,500	10 to 20	..
Tennessee—				
Dyersburg		5,000		m
Fayetteville—Has just completed sewer system. House connections to be laid this year.				
Franklin		600		c
Newport—$5,000 for extensions.				
Texas—				
Childress	30,000	7 mi.	6 to 15	m
Childress—Disposal plant.				
Ft. Worth—Sewage disposal plant.				
Greenville		50,000		m
Greenville—Disposal plant to let June 1, also extensions to sewers.				
Longview—Considering disposal plant.				
Paris		3,000	6	..
Paris—$10,000 for activated sludge plant.				
Quanah—Plans for $25,000 sewers and disposal plant in preparation.				
Sulphur Spgs.	2,000			m
Waxahachie		0.8		m
Waxahachie—Disposal plant by January, 1917.				
Utah—				
Ogden		10,000	8	c
Ogden		4,500j	33 to 51	c
Provo	Some.			
Vermont—				
Middlebury	400			m
Virginia—				
Harrisonburg		1,000		m
Harrisburg—$6,000 for Imhoff tank and sludge beds.				
Staunton		6,000	8, 10	m
Washington—				
South Bend—$1,000 for 2x2 ft. wooden box storm sewer.				
Tenino		2 mi.		..
Tenino—Septic tank, 30 by 90 ft.				
Vancouver	760	850	8	c
Walla Walla	12,000	15,000	6 to 15	..
Wisconsin—				
Antigo	Some.			
Ashland		1,000	6	m
Baraboo		2,500		..
Beloit		6,000	6	c
Chippewa Falls		2½ mi.	12 to 24	..
Eau Claire		10,000		m
Janesville—Some vitrified pipe.				
Janesville		2,000j	m	..
La Crosse	42,186	3,516a		c
La Crosse—Sizes are 46x69 and 40x60, to be brick, reinforced concrete or segment block.				
Lake Geneva—Disposal plant.				
Madison		30,000	6 to 24	c
Manitowoc	7,000	6,500	8 to 18	..
Marshfield—Contemplate building two new sewage disposal plants.				
Marshfield		1,261	8 to 24	c
Racine		6,530	8 to 21	c
Racine		1,605j	24, 30	c
S. Milwaukee		3,000	8	c
Waukesha	6,000	6,000		..
W. Allis	Some.			
CANADA—				
Alberta—				
Calgary—$8,500 sewer appurtenances.				
Ontario—				
Hamilton		6,000		..
Ottawa	310,000	2 mi.x		c
St. Catharines	40,000	2,300		c
St. Catharines	8,000	3,000		m
St. Catharines—$20,000 system being planned, also small disposal plant.				
Stratford		8,000	9, 12	..
Stratford		6,600j	48	..
Saskatchewan—				
Regina	10,000	4,169	15, 18	..

WATER WORKS IMPROVEMENTS—1916.

WATER WORKS.

(Cast iron mains unless otherwise noted.)

State and City	Appro-priation	Length Ft.	Cy. or Contract	Size In.
Alabama—				
Dothan—Considerable.				8, 6
Jacksonville—Owners contemplate sand filters.				
Ozark—Will improve pumping station.				
Arizona—				
Phoenix		18,000	..	6,4
Phoenix—Water filtration plant in contemplation; no appropriation yet.				
Arkansas—				
Paragould—Ark. Lt. & Power Co. will change pumping station from steam to electric.				
Tuckerman—Building new water plant.				
Wynne—$20,000 to improve and enlarge water and light plant.				
California—				
Orland—Probably auxiliary steam plant for pumping water.				
Richmond—Water filtration plant under consideration by water commissioners.				
Santa Ana		4,000	..	4
Santa Rosa		2,000	m	
Sierra Madre	$6,000	8,000	m	4,5,6
Sierra Madre—$3,700 for 26-inch well.				
Sierra Madre—Pumping machinery will be considered.				
Venice—Pumping engine for fire protection.				
Colorado—				
Colorado Sp'ngs		500	m	4,6,8
Durango		Repairs	w m	16,16
Ft. Collins	5,000	2,000	..	4,8,10,12
Longmont			m	4-8
Connecticut—				
Danbury—Some.				
East Hartford		26,000	..	16-12
Southington		10,000	m	
District of Columbia—				
Washington	Some			
Washington—5,000,000-gal. centrifugal pump contract awarded to DeLaval Steam Turbine Co.				
Florida—				
St. Augustine		10,000	..	12-4
Georgia—				
Athens—$10,000 appropriation for aedimentation basin.				
Cedartown —Adding 600-gal. motor-driven centrifugal pump.				
Idaho—				
Moscow—Some.				
Illinois—				
Berwyn	30,000	30,000	c	6
Berwyn—$10,000 in improving pumping station.				
Carrolton—$2,500 of improvements probable.				
Charleston—About $800 appropriated for clear water basin.				
Chicago Hei'ts.		600	..	6

State and City	Appropriation	Length Ft.	Cy. or Contract	Size In.
E. Moline		1,701	..	
Galva—2 wells, 1,525 feet.				
Fairbury—Probably 1 deep well pump in new well to be drilled this summer.				
Kewanee—70,000 will be spent for improvements.				
Madison—$10,000 will be spent for improvements.				
Moline		26,000	10,000 ..	6 to 12
Oak Park		36,477	18,981 c	6 to 10
Paris—New concrete dam to cost $94,000.				
Waukegan		16,260	6,180 c	16
W. Frankfort			..	4 to 10
Indiana—				
Crown Point			1,000w m	
Crown Point—Filtration plant is needed.				
Frankfort			1,000 co	6
Lafayette			1,300 m	6
Marion			2,500 m	6,8
Noblesville—$3,800 a year appropriation for water works pumping station.				
Portland—Water main extensions recommended.				
Iowa—				
Cedar Falls			3,000 ..	4,6
Cherokee—Some 6-in. pipe.				
Marshalltown—New 4,000,000-gal. Allis Chalmers pumping engine will be installed about June.				
Pella			15,000 m	6
Sioux City			1,000 tons ..	4 to 16
Sioux City—$12,000 pumping station.				
Spencer	$15,000	20,000	m	
Kansas—				
Iola—May purchase liquid chlorine sterilization plant.				
Lawrence—$60,000 for water mains, $45,000 for filtration plant and enlargement of pumping station in prospect.				
Lyons		1,000	c	4
Neodesha—Probably 2 new boilers.				
Osawatomie		2,300	c	10
Ottawa—$15,000 filtration plant contemplated.				
Louisiana—				
Patterson—$5,500 appropriation for filtration plant.				
White Castle	$3,500		m	
White Castle—New water and light plant will be built.				
Maine—				
Lewiston		1mi	..	
Van Buren	$00		m	6
Van Buren	3,000		w	8
Massachusetts—				
Brookline		3mi	..	6 to 12
Brookline—To finish plant started last year.				
Brookline—Pumps for filter plant.				
Lawrence—Probably extensive repairs on filtration plant.				
Lenox—Co. will probably build reservoirs.				
Manchester—$10,000 repairs to pumping plant to be done by city.				
Norwood	$4,900	5,000	..	6
Norwood—$1,500 for open wells.				
Revere	$20,000		m	
Michigan—				
Alpena		3,000	..	6 to 12
Battle Creek		15,000	m	6 to 18
Detroit			5mi	
Eaton Rapids		400	..	
Flint		80,000	..	
Greenville—New pump, probably.				
Hastings		7,000	m	
Hastings—150-h.p. boiler.				
Jackson	$65,000	31,356	m	6 to 12
Jackson—500,000-gal. reinforced concrete reservoir.				
Marshall		2,000	m	4,6
Menominee—Exyects to build filter plant.				
Onaway		2,000	..	4,6
Sault Ste Marie		2,000	..	8,10
Minnesota—				
Albert Lea		15,000	c	4,6
Bemidji		1,600	..	4
Cloquet		500	..	6
Cloquet—Plans preparing for $2,000 concrete reservoir.				
Faribault		6,000	m	6,8
Hopkins			1mi c	6,8
Mankato		600	c	12,16
Mankato—New 1,200-ft. artesian well.				
Mankato—1,500,000-gal. concrete covered reservoir.				
New Ulm—Several blocks of new mains and new deep well pump and apparatus.				
St. Paul—$400,000 new reservoir.				
Thief River Falls—Filtration plant possible.				
Virginia—Some mains, small well and pumping station.				
Willmar		4,200	c	4,6
Mississippi—				
Starkville		1,350	m	6
Missouri—				
Kansas City—5,000 tons water pipe.				
Liberty—A few 4-inch additions.				
Webster Grove—About 50 mi.				
Montana—				
Bozeman—$200,000 water and sewer bonds to be voted on shortly.				
Miles City			1mi m	4,6
Nebraska—				
Alliance—500,000-gal. reinforced concrete reservoir.				
Chadron		1,200	c	4
Gerring—Will probably extend water mains.				
Lincoln		25,000	m	4 to 12
Seward		2,000	c	4,6
New Jersey—				
Bloomfield		3,500	..	6 to 12
Glen Ridge—Some.				
New Brunswick—New dam, pumping machinery, filter plant and standpipe.				
New Mexico—				
Albuquerque—Election on municipal plant April 4.				
Raton		3,200	c	4
New York—				
Buffalo		10 mi	m	
Ellenville		800	m	8
Geneva		2,000	m	
Geneva—Additional filter unit.				
Glens Fals—Some.				
Herkimer		20 mi	c	14
Hudson		300	..	4
Johnston	$1,500	2,500	..	
Lockport		1,500	..	6
Norwich		p	..	
Plattsburg		1,000	..	4 to 12
Plattsburg—Liquid chlorine plant.				
Watertown		5,000	m	
Wellsville		5,000	c	6 to 12
Wellsville—Part of $250,000 contract for plant and mains.				
Watertown—$50,000 addition to water plant.				
North Carolina—				
Asheville		3,000	m	6,10
Greensboro		12,000	..	6 8
Lumberton		1,000	..	
Lumberton—$2,792 for four horizontal centrifugal electric-driven pumps.				
Plymouth	$25,000	10,000	..	
Plymouth—$25,000, 15,000 galv. iron.				
Plymouth—Pumping station, tower and tank.				
Wilson—$95,000 for improvements to water plant, including 3,000,000-gal. filter plant.				
North Dakota—				
Fargo		1,000	..	6 to 12
Minot	$18,057	11,119	c	6,8
Minot—Pumping station improvements.				
Ohio—				
Barnesville—Plans for $25,000 filtration plant in preparation.				
Chardon—Drilling well and plans for water works will follow.				
Cuyahoga Falls—Some.				
E. Palestine	$35,000	6,500	m	6 to 16
E. Palestine—Appropriation includes wells and pumps.				
Fostoria	$2,000	1,500	..	4,6
Fostoria—$75,000 for 175,000,000-gal. concrete lined reservoir and 2,500,000-gal. rapid sand filter.				
Greenville		1,600	c	4
Greenville—Probably $35,000 of improvements.				
Lima		10,000	m	4 to 10
Mansfield—Some.				
Middletown—Plans in preparation.				
Norwood		5,000	m	4 to 8
Painesville		5,000	..	4 to 8
Ravenna		1,600	c	
Ravenna—$100,000 for diversion dam and conduits.				
Steubenville—$300,000 new covered reservoir.				
Oklahoma—				
Enid	$5,000		..	6 to 18
Enid—$10,000 bond issue to extend tunnels.				
Oregon—				
Ashland	Steel	6,000	m	8,12
Ashland		2,600w	m	12
Portland	$150,000	15 mi	..	
Pennsylvania—				
Bethlehem		1,900	m	6
Blossburg		1,800	..	4,6
Norristown—Some 4 to 10-ft. pipes.				
Northeast—Will relay some water mains.				
Oil City		5,000	..	6
Punxsutawney—Working toward municipal water plant.				
Renovo—Pumps and 150,000-gal. reservoir.				
Ridgway		2,000	m	6
Rhode Island—				
Woonsocket—Considerable.				
South Carolina—				
Columbia	$200,000		c	6 to 12
Columbia—Extensions probable, including six 1,000,000-gal. filter.				
South Dakota—				
Aberdeen		6 blocks	..	4,6
Mitchell	$850	420	m	8
Sioux Falls		10,000	m	6,8
Yankton		1,700	..	4
Tennessee—				
Bristol—2,000,000-gal. reservoir.				
Dyersburg		2,500	m	6
Newport—$5,000 for extensions.				
Paris—$5,000 for deep well.				
Texas—				
Childress	$10,000	10,000	m	8
Ft. Worth—Enlargement of filter plant and supply conduit.				
Lufkin		2 mi	..	
Lufkin—$10,000 pumping unit to be installed.				
Paris		3,000	..	4
Quanah		2,260	c	6
Sulphur Sp'gs.	$6,000		m	8
Waxahachie		2.6 mi	m	
Utah—				
Provo		2,000	..	4
Vermont—				
Randolph		2,000	..	6 to 10
Virginia—				
Harrisonburg		5,000	m	
Staunton		5,000	m	4,6
Washington—				
Sunnyside		1,000w	..	
Tenino		7,000w	co	6 to 10
Wisconsin—				
Antigo		2,500	c	6
Eau Claire		4,600	m	4 to 10
Janesville—Some 4 and 6-in. extensions.				
La Crosse		1,200	..	6
Madison		25,000	m	6 to 20
Madison—$200,000 to rebuild pumping station.				
Manitowoc		3,000	m	6
Manitowoc—Light and water plant, 3,000,000-gal. pump.				
Marshfield		3,254	c	4,6
Menasha		½	mi ..	
Menasha—Filtration plant to be built this summer, costing about $115,000.				
S. Milwaukee		4,000	c	6
Waukesha		8,000	m	
W. Allis—Some 6-in. pipe.				
CANADA—				
Alberta—				
Calgary—$124,700 enlargement of reservoir and extensions of mains and connections.				
Ontario—				
Hamilton		7,000	..	6
Ottawa—$50,000 short main extensions, 4 to 12.				

ORNAMENTAL STREET LIGHTING—1916.

STREET LIGHTING.

Alabama—

Dothan—Contemplate extension of White Way by city.

Ozark—Eight 5-lamp ornamental standards, 110 and 60 watt lamps by city.

Arizona—

Phoenix—Three hundred standards with 110-volt lamp by city.

Arkansas—

Paragould—Seventy-seven 5-lamp standards, 200 c.p. to each standard by company.

Tuckerman—Building electric light plant.

Wynne—Will spend $20,000 improving and enlarging municipal water and light plant.

California—

Colusa—Twenty standards with 40 lamps.

Orange—Forty-four standards with 44 400-c.p. lamps.

Richmond—Two hundred standards with 200 110-volt lamps by company.

Santa Ana—Seventy standards with 70 400-c.p. lamps by city.

Colorado—

Ft. Collins—Twenty-six standards with 3 and 5 110-volt, 7-ampere lamps. May change system and instal 800 series in-

candescent 110-volt, 7-ampere lamps. Company pays for construction city for operation.

Connecticut—

Wallingford—$3,000 appropriated for proposed White Way on Main st. A. L. Pierce, supt. electric plant.

Willimantic—Has 133 standards with 133 60-watt lamps at $20.50 a year and 100 standards with 100 320-watt lamps at $80 a year.

Florida—

Palm Beach—Five 5-lamp ornamental standards with 110-volt lamps.

Sanford—Fifty standards with 150 600-v. d.c. lamps.

Georgia—

Toccoa—Fifty single lamp standards with 250-c.p. lamps to be installed by city.

Illinois—

Belleville—Sixty-five ornamental light standards with 65 400-c.p. lamps will be put in by company.

Berwyn—Twenty-four ornamental light standards with 24 220-volt lamps will be put in by city.

Chicago Heights—Will soon make contract with Public Service Co. or Chicago Heights Gas Co. or possibly city will put in ornamental light standards.

Delavan—Three 5-light standards with 32-w. lamps will be put in by city.

Galva—Forty-three 5-lamp standards of 40-watts each to be put in by city.

Greenville—Twelve 5-lamp standards to be put in by city.

Oak Park—Have contracted for many new street lamps and substitution of 250-c.p. nitrogen mazda lamps for the 400 or more arc lamps now in use.

Whitehall—Will vote this spring on bonds to build municipal electric light plant and distribution lines to cost $28,000.

Indiana—

Alexandria—Has been considering ornamental lighting, but nothing has been done yet.

Anderson—Municipal light plant will spend $150,000 for boilers, coal conveyor, etc.

Crown Point—Ten ornamental light standards with 3 100-volt lamps each to be put in by city.

Huntington—Now installing 391 single light standards 21.6 and 14.4-watt lamps; city operates.

Noblesville—Company to put in 34 600-c.p. lights on single-light standards.

Richmond—Has let contract for new $30,000 unit of municipal lighting plant.

Seymour—Merchants contemplate ornamental lighting led by Nathan Kauffman.

Union City—City will put in 60 single-lamp ornamental standards.

Wabash—Ornamental lighting contemplated.

Warsaw—Ornamental light under consideration.

Iowa—

Manchester—City will put in 60 5-light and 15 single light standards, 110-volt lamps.

Kansas—

Holton—Expect to build 23 miles of transmission lines. Will purchase 50-k.w. transformer, lightning arresters, panel for switchboard and possibly a new engine and generator.

Hutchinson—One hundred 4-lamp standards; city pays for installation.

Lyons—Sixteen 3-light standards.

Ottawa—Contract awarded for new White Way, $7,130 appropriated for installation on 6 blocks, 80 single lamp, iron standards, 400-c.p. lamps. Contemplate new steam turbine in municipal light and water plant.

Wellington—City will install 30 ornamental standards.

Louisiana—

White Castle—Will build new water and light plant.

Maine—

Van Buren—Have just installed 3 mi. of lighting system.

Massachusetts—

Lawrence—White Way under consideration on one principal street.

Norwood—$16,000 appropriation for underground electric wire conduit.

Michigan—

Detroit—Ninety-six 1,000-v. lamps on 96 standards will be put in.

Eaton Rapids—Twenty single lamp standards will be put in by city.

Sault Ste Marie—Sixty-six 400-c.p. single lamp standards will be put in by city.

Minnesota—

Sauk Center—White Way under consideration.

Missouri—

Pierce City—Twenty-seven two lamp standards will be put in by city.

Warrensburg—Ornamental lighting being agitated.

Montana—

Deer Lodge—Probably 100 6.6 amp. single lamp standards to be put in by city.

Nebraska—

Gering—Fifty new lamps.

Havelock—Fifteen or 16 new ornamental standards.

New Jersey—

Ridgwood—Seventy-five 60 c.p. single lamp standards to be put in by the city.

New Mexico—

Raton—Municipal light plant voted on in April.

New York—

Ellenville—Fifty-eight 400 c.p. standards by company.

Herkimer—About 30 500-watt single lamp standards to be put in by city.

Schenectady—One hundred single lamp standards to be installed by city.

Utica—May be some by property owners.

Watertown—Fifty 3 to 5-light standards, 60-v. lamps will be installed by lighting company.

North Carolina—

Gastonia—Sixty-three single light standards,600 -c.p.. lamps to be installed by city.

Lamberton—$9,947 to be spent on changing electric system to alternating current, company to furnish current.

North Dakota—

Fargo—One hundred and two single light standards, 80 c.p. lamps to be installed by city.

Minot—One hundred 5-light standards, 40 and 60-watt lamps to be put in by city.

Ohio—

Bellefontaine—One hundred and one single-light standards, 600-c.p. lamps, to be put in by city.

Chicago Junction—Municipal light plant may install ornamental lights.

Dayton—Four hundred and one 5-light standards by company.

Norwood—One hundred and fifty 110-v. lamp standards by city.

Oklahoma—

Bartlesville—Possibly in proposed new park.

Mangum—Possibly a lighting plant.

Okmulgee—Forty-eight single-light standards, 300-c.p. lamps, to be put in by city.

Oregon—

Eugene—One hundred and fifty 6-light standards, 110-volt lamps, by city.

Pennsylvania—

Blossburg—Ten 3-light standards, 110-volt lamps, by city.

Carbondale—Under consideration.

Lykens—Forty-five suspended lamps, 250-c.p. 110-volt, nitrogen.

South Dakota—

Madison—$16,000 building for city lighting plant.

Tennessee—

Dyersburg—Electric light extensions.

Newport—$5,000 bond issue for electric street lighting and wiring.

Paris—Considering 20 5-light standards.

Texas—

Paris—Seventy single-light standards, 100-watt lamps, by city, probable.

Wisconsin—

Chippewa Falls—One hundred and eighteen single-light standards, 400-c.p. lamps, by city.

Janesville—One hundred and thirty single-light standards, by city.

La Crosse—Ten or 12 5-light standards, 80 to 100-ampere lamps, by city.

Madison—One hundred and forty-five single-light standards, 1,000-c.p. lamps, by city.

Manitowoc—$70,000 water and light plant.

Menasha—Sixty-five single light standards, by city.

CANADA—

Alberta—

Calgary—$46,000 for switch board and equipment, underground cable, storage batteries, lightning arresters and appurtenances.

BRIDGES—1916.

BRIDGES.

Alabama—

Dothan—Will build some small bridges.

Arizona—

Nogales—Two concrete bridges.

Arkansas—

Arkadelphia—One 40-ft. bridge considered.

California—

Hermosa Beach—Viaduct contemplated.

Placerville—One concrete bridge, $700 appropriation.

Redondo Beach—One wooden bridge 81 ft. long, 20-ft. roadway will be let by contract May 1.

Sierra Madre—One wooden bridge, appropriation $195.

Venice—One concrete bridge, $8,000 appropriation.

Colorado—

Colorado Springs—Two wooden bridges, 63-ft. span and 3 conduits.

Connecticut—

Bristol—$10,000 appropriation for bridges.

Southington—One bridge, $1,000, to be built by town and state, and one at $2,500 to be built by county and state.

District of Columbia—

Washington—$110,000 appropriation for grade-elimination viaduct

Florida—

Lynn Haven—$25,000 bonds to be sold to build 2 bridges of about 100-ft. span each.

Sanford—100-ft. steel bridge and 900 ft. of trestle approaches.

Georgia—

Cedartown—$2,000 appropriation for 50-ft. concrete bridge now under construction.

Idaho—

Moscow—$3,000 concrete bridge in contemplation.

Illinois—

Berwyn—Has $7,000 appropriation for bridges.

Chicago Heights—One concrete arch.

Collinsville—Cantine Creek bridge.

Marion—$5,000 for bridges.

Rockford—$82,000 concrete bridge over Rock River at Morgan St., let to J. J. O'Heron & Co., of Chicago, Ill.

Salem—Nine reinforced concrete bridges on county roads let at $10,550.

Waukegan—Bridge on Sheridan road.

Indiana—

Bluffton—Over $20,000 worth let to C. T. Kain March 8, all steel and concrete.

Frankfort—One small concrete bridge, appropriation $1,000.

Richmond—Two bridges by county commissioners.

Iowa—

Anamosa—County will build about 25 bridges, steel on concrete abutments, with concrete floors, up to 70-ft. span.

Burlington—Bridge across Mississippi river let to Wisconsin Bridge Co.

Cedar Falls—Bridge across Cedar River, 5-span concrete arch or steel girder.

Kansas—

Iola—One bridge by city and 2 by Mo. Pac. Ry.

Lyons—Several reinforced concrete culverts, four over 6-ft. span.

Topeka—Three reinforced concrete bridges; appropriation, $25,000.

Louisiana—

Kentwood—Possibly some.

Maine—

Lewiston—One hundred twenty-five ft. steel bridge.

Maryland—

Frederick—One small concrete foot bridge.

Massachusetts—

Brookline—Two steel and concrete highway bridges.

Lawrence—Two bridges to be built by city or local corporation.

Revere—Small concrete bridge.

Michigan—

Ann Arbor—Plans for $10,000 to $15,000 bridge.

Eaton Rapids—One small bridge.

Holland—Three very small bridges.

Monroe—Two bridges, appropriation $60,000.

Minnesota—

Bemidji—$17,000 steel and concrete bridge.

Cloquet—$977 repairs to bridge.

Faribault—$1,000 for three small bridges.

Mankato—Bridge with five 90-ft. arches, 32-ft. roadway with street cars, two 6-ft. walks.

Nebraska—

Alliance—Two bridges 40-ft. span, 16-ft. roadway.

Lincoln—$3,000 appropriation.

Seward—One concrete bridge, $1,000.

New Jersey—
Irvington—$13,000 appropriation.
Lambertville—Hunterdon county plans new bridge.
Newark—Three new concrete bridges in the township.
Wenonah—$14,000 appropriation and $27,000 bonds for county bridges.

New Mexico—
Albuquerque—Several small wooden bridges rebuilt.

New York—
Buffalo—Three bridges, costing $184,700.
Elmira—$4,000 appropriation for small reinforced concrete bridge and retaining walls.
Gloversville—Reinforced concrete 30-ft. span, 50-ft. width.
Lackawanna—$4,000 for one bridge.
Niagara Falls—Flat concrete arch, 25-ft. span, 50-ft. wide, $5,000; grade crossing elimination, $454,000.
Oneonta—Two slab-floor bridges, $2,000.
Watertown—One $25,000 concrete bridge will be let about April 1.

Ohio—
Cuyahoga Falls—Will probably widen Portage street bridge.
Dayton—Three concrete bridges, estimated at $500,000.
East Palestine—$1,000 for 18-ft. concrete culvert.
Norwood—Three concrete bridges proposed.

Oklahoma—
Enid—$30,000 bond issue for concrete bridges proposed.
Okmulgee—$25,000 bonds for bridges probable.

Oregon—
Astoria—About $6,500 ft. of street to be improved by constructing viaduct.
Portland—$530,000 appropriation for nine viaducts.

Pennsylvania—
Peckville—Lackawanna Co. Commrs. will build concrete bridge over Lackawanna river.
Blossburg—Two bridges.
Carbondale—Three small bridges.
Meadville—$5,000 for three concrete slab bridges.
Norristown—$25,000 bridge, $5,000 park bridge.
Portage—Twenty-five-ft. span, 50-ft. width reinforced concrete.
Rankin—Probably one.
Scottdale—$2,600 for two small concrete bridges.

Rhode Island—
Woonsocket—$10,400 for two small bridges.

South Dakota—
Lead—One bridge.
Yankton—$5,000 for 50-ft. concrete arch.

Tennessee—
Bristol—One bridge.

Vermont—
Randolph—One or two.

Virginia—
Harrisonburg—Probably two.
Staunton—Two bridges.

Washington—
Sunnyside—$500 for two bridges.
Walla Walla—$6,000 for two reinforced concrete girders.

Wisconsin—
Beloit—Possible three 70-ft. arch concrete Central Bridge.
Janesville—Redecking or new bridge over Rock river.
Madison—$8,500 for concrete arch.
West Allis—$2,000 for one concrete bridge.

CANADA—

Alberta—
Calgary—Three concrete bridges, $58,000, $375,000 and $75,000.

GARBAGE DISPOSAL, PUBLIC BUILDINGS AND MACHINERY—1916.

GARBAGE DISPOSAL PLANTS.

Alabama—
Anniston—Expects to build $5,000 crematory.

California—
Venice—Garbage incinerator proposed.

Illinois—
Moline—Garbage incinerator contemplated.

Massachusetts—
Brookline—May build incinerating plant.

Michigan—
Traverse City—Incinerator to be voted on.

Minnesota—
Hopkins—Probably instal incinerator.

New Jersey—
Glen Ridge—Incinerator costing $15,000.

New York—
Buffalo—Twenty-ton destructor.

Pennsylvania—
Blossburg—New site and plans under consideration.
Rankin—Will purchase motor garbage truck.
Titusville—Plans will be completed this year.

Tennessee—
Franklin—Considering incinerator.

Wisconsin—
West Allis—Disposal plant, $4,600.

PUBLIC BUILDINGS AND OTHER STRUCTURES.

Alabama—
Dothan—Remodeling of fire and police station.

Arkansas—
Hope—Four-story bank building.

California—
Long Beach—New bulkhead on west beach, plans under way; also for flood protection. Petition for $500,000 horse-shoe pier will be voted on.
Venice—Ocean front protection. Concrete tunnel 6 ft. by 10 ft. 1,000 ft. long.
Durango—$175,000 high school building, bonds sold $150,000 Federal building, appropriation made; $50,000 building for Modern Woodmen contemplated.

Connecticut—
Wallingford—$125,000 high school.

Iowa—
Atlantic City—City hall, $25,000; two hotels, $30,000 each, and other smaller buildings.

Kansas—
Columbus—$55,000 county high school.
Neodesha—$20,000 hospital, $20,000 office bldg.

Kentucky—
Owensboro—$40,000 city hall.

Massachusetts—
Manchester—$6,000 for fire prevention apparatus in three buildings.

Minnesota—
Virginia—City hall to be built.

Mississippi—
Gulfport—$75,000 county court house, $500,000for grounds and buildings of Mississippi Centennial.

Nebraska—
Gering—Large high school building, large sugar factory, much building in all lines.

New York—
Plattsburg—$200,000 city hall will be started this spring.

North Carolina—
Burlington—$30,000 for city hall, $38,000 for school, $65,000 for postoffice, $30,000 for office building.

South Dakota—
Madison—$15,000 for city lighting plant building.

Tennessee—
Bristol—$60,000 high school building.

Wisconsin—
Lake Geneva—$28,000 city hall.

MACHINERY AND SUPPLIES TO BE PURCHASED.

Arizona—
Nogales—Concrete mixer.

Arkansas—
Helena—May purchase sewage pumping machinery.

California—
Petaluma—Steam 5-ton tandem roller.
Visalia—Considering purchase of a tractor or roller and a sweeper. Kinds not yet decided.

Colorado—
Ft. Collins—Will probably need a large concrete mixer.
Longmont—Probably some street cleaning machinery.

Connecticut—
Putnam—Street sweeper or flusher.

Delaware—
Milford—May purchase a street sweeper.

Florida—
Sanford—Road roller, wheeled scrapers, dump wagons for use on a combined city and county road job with a $500,000 bond issue.

Illinois—
Belleville—Possibly a road roller.
Chicago Heights—Steam roller, large grader, scarifier and probably a sweeper.
Mt. Pulaski—Tank wagon for oiling streets, probably buying one now owned by business men's committee.

Indiana—
Bluffton—Expect to purchase 1,200-yd. motor-driven asphalt plant and steam heater for asphalt.
Crawfordsville—Expect to purchase a combination heater and pressure distributer for oiling streets.
Gary—A 10-ton roller and a 1½-ton auto delivery truck.
Marion—Just purchased 1,600-gal. Studebaker sprinkler and 1-horse dump cart.
West Lafayette—Probably grader or drag.

Iowa—
Davenport—Sprinkler wagon, road grader, two or three plows, shovels, etc.
Pella—Need gasoline 8-ton road roller.

Kansas—
Holton—See under "Lighting."
Lawrence—Street sweeper.
Lyons—Road grader.

Kentucky—
Pikeville—Brooms for sweepers.

Louisiana—
White Castle—For new water and light plant.

Massachusetts—
Brookline—Steam road roller and scarifier. Pumps for filter plant.
Revere—Steam roller; paving mixer; small compressed air plant; water-main tapping machine.

Michigan—
Dertoit—Probably a trench excavator and several trucks.
Flint—Revolving type steam shovel; sewer excavating machine; crane for unloading gravel from cars.
Hastings—Possibly a 150-h.p. high pressure boiler for water works.
Holland—Possibly a mechanical tamper.
Ludington—Possibly an asphalt mixer and a tandem roller.

Minnesota—
Albert Lea—Lifting apparatus for sewage.
Hibbing—New power plant talked of.
Mankato—Street cleaning machine.
New Ulm—Deep-well working head, 7¾-in. barrel pump, 80-lb. pressure, 60-h.p. motor; estimated cost $5,000.
Willmar—Probably new generator for electric light plant.

Missouri—
Sedalia—Probably street graders.

Nebraska—
College View—Possibly new pump, street sweeper, street sprinkler.
Wahoo—175 Kva. generator, direct-connected to 225-h.p. Corliss engine.

New Jersey—
New Brunswick—Two 5,000,000-gal. turbo-centrifugal pumps.
Passaic—Street flushing machine.
Rahway—Vacuum street sweeper, scarifier.

New Mexico—
Albuquerque—Probably new street equipment and sewage pump.
Raton—Eight or twelve-h.p. gas engine and rock crusher.

New York—
Jamestown—Possibly steam roller.
Lockport—Stone crushing machinery.
Niagara Falls—Three-ton steam roller.
Plattsburg—Liquid chlorine plant.
Utica—Sewer cleaning machine.

North Carolina—
Lumberton—Four horizontal centrifugal pumps, electric drive.
Plymouth—Possibly road roller.
Rockymount—Concrete mixer.
Wilson—Pumps; gas plant.

Ohio—
East Palestine—Pumping engine, pumps and boilers.
Greenville—Street sweeper.
Newark—Probably 300-kw. turbo-generator and boilers.

Pennsylvania—
Bethlehem—Gasoline road roller, motor street flusher.
Franklin—Probably a truck.
Meadville—Small concrete mixer and small tar kettle.
Rankin—Motor garbage truck.
Scottdale—Roller; street flusher.

Waynesboro—Portable crusher; heating kettle.
Wilkes-Barre—Street cleaning apparatus.

South Carolina—
Bennettsville—Seventy-five-ft. 40-in. steel smoke stack; possibly electric driven pumps.

South Dakota—
Aberdeen—Booster pump and 125-h.p. motor for sewage pumping station.
Mitchell—Street flusher; street sprinkler.

Tennessee—
Dyersburg—Street flushing machine, motor truck.

Texas—
Childress—Probably trenching machine.

Vermont—
Middlebury—Dust-laying apparatus; 2-horse road machine.

West Virginia—
Moundsville—Possibly dump wagon and garbage cart.

Wisconsin—
Baraboo—Stone crusher.
Eau Claire—Meter tester, vertical turbine, motor car for water department.
Janesville—Road roller, road oil distributor with pressure devices, motor car in water department.
Manitowoc—Three 300-h.p. boilers, 750-k.w. turbo unit with all auxiliaries.

COMPARISON WITH CONDITIONS IN 1915.

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Alabama—
Dothan—More in 1916.
Jacksonville—Work started last year will take all the funds.
Mobile—Business conditions brighter. Improvements made on petition and cannot be predicted now.
Ozark—Much better prospects for 1916.

Arizona—
Nogales—About 50 per cent. more of various improvements than in 1915.
Phoenix—More paving and work of all kinds.

Arkansas—
Helena—General prospects 1916 poor, 1915 was good.
Hot Springs—Will do more in 1916 than in 1915.
Jonesboro—Prospects far better in state in lines of construction work. City will do far more than in 1915.
Pine Bluff—Plans not made until after April 1.

California—
Anaheim—More paving and not so much sewer work.
Colusa—Not so promising. Town will do as little work as possible.
Hollister—About the same.
Los Gatos—Less in 1915. City heavily bonded.
Marysville—New council comes in April 1 and will plan work.
Oakdale—Will do more in 1916, owing to the country being developed.
Oakland—Probably somewhat less than in 1915.
Orange—Too early to estimate.
Petaluma—Street and highway work good in 1916.
Pittsburg—Not much better than 1915 in street and sewer work. Will do considerable of both, not yet lined out.
Placerville—Will do considerable street paving if bond election carries in April.
Redondo Beach—Outlook for 1916 good for considerable work, especially in street paving; no street work done in 1915.
Richmond—Not as much as in 1915, which was a big year, but better class of pavements will be laid.
Santa Ana—Possibly more paving than in 1915. Prospects better.
Santa Rosa—Will do some work, and considerable if court decision on it is favorable.
Turlock—Will do more work than in 1915.
Vallejo—More work than last year, especially in paving.
Visalia—Prospects for paving better than for many years.

Colorado—
Colorado Springs—Construction work will not be as heavy as in 1915.
Durango—Prospects for 1916 are much brighter.
Ft. Collins—More paving than any previous year.
Grand Junction—City work about the same. Generally better year is expected.
Leadville—Is struggling under a judgment debt and will do little improvement for seven years.
Longmont—Will do about 50 per cent. more concrete paving.

Connecticut—
Anson a—Very little construction work this year.
Bristol—About the same.
Danbury—Times will be better.
Greenwich—Each year about the same.
Manchester—Prospects better and will do more work.
New Canaan—Will do road work chiefly.
Norwalk—Expect to do more than twice as much work as in 1915.
Putnam—Very little work contemplated on account of high cost of labor and material.
Southington—New work will be light on account of high prices and scarcity of labor.
Wallingford—Not much paving, sewers or water mains, as prices of materials and labor are too high.
Wethersfield—No new work, merely resurfacing old macadam.
Willimantic—About same as in 1915.

Delaware—
Milford—Probably not as much city improvement as in 1915.

District of Columbia—
Washington—About the same prospects for work as in 1915.

Florida—
Live Oak—Nearly stops work this year to recover from complete sewer system, new pumping station and vitrified brick paving recently constructed.
Lynn Haven—Will probably not do as much as last year.
Palm Beach—Will probably build more streets, sidewalks and sewers than last year. About half of a $100,000 bond issue remains to spend on streets, sewers and sea wall. Extension of city limits will require much city improvement work soon.

Georgia—
Carrollton—General conditions improving.
Macon—Will do more curb, sidewalk and storm sewer work in 1916.
Moultrie—Stopped improvements to recover from 15,000 sq. yds. asphalt concrete and 3,000 sq. yds. concrete sidewalks.
Toccoa—General condition improving.

Idaho—
Blackfoot—Will do more work in 1916, principally paving.
Boise—Will probably do no work except the paving program outlined under Miscellaneous Street Improvements.
Moscow—More paving, storm sewers and cement sidewalks.

Illinois—
Alton—Will do much more work in 1916, especially in paving and sewers. $100,000 for sewers and $200,000 for paving, all to be done by contract and paid for by local assessment bonds.
Belleville—Will do more paving work.
Berwyn—Will do more work in 1916 in pavements, vitrified pipe sewers, water mains and electric light system.
Charleston—Did no work last year and will do little or no work this year.
Chicago Heights—Prospects are much brighter, especially in pavements.
Collinsville—No work to be done except oiling of streets.
Danville—About the same as last year.
East Moline—More paving and storm and sanitary sewers than in 1915.
Freeport—Expect to do a great deal more paving.
Galva—More paving and sidewalks than in 1915.
Granite City—Considerable paving and sewer work for 1916, including $110,000 outlet sewer.
Herrin—Very little will be done this year.
Kewanee—No paving or sewer improvements contemplated this year.
LaGrange—About the same as 1915.
Lake Forest—Hope to do more paving this year.
Lawrenceville—About same as last year.
Madison—Will build nothing but the sewer system, $155,000.
Marion—Prospects good.
Mattoon—Business looks good for 1916.
Momence—No prospects until after spring election.
Mt. Pulaski—Expect better business in 1916.
Murphysboro—Construction prospects are brighter for 1916. Will probably do more sewer work.
Oak Park—Have planned a third more paving than last year and largely increased sewer and water main construction.
Polo—Is well sewered and needs very few more sidewalks.
Taylorville—Will probably do more than in 1915. Sewer system costing $55,000 probably most of work to be done.
Waukegan—Will have more work than last year in water and sewer extensions, and water works improvements.
Wheaton—Prospects look good for land reclamation by drainage. No city work in sight at date of report.

Indiana—
Brazil—About the same as 1915.
Covington—Not much work in city in 1916, but fully as much in county.
Crawfordsville—Will build less sidewalks, curb and gutter, but will build more paving and sewers and oil more streets.
Crown Point—1916 will be almost normal; probably less than 1915.
Elwood—About same as 1915.
Frankfort—Will do about twice as much work as last year, principally in sewers.
Gary—More than last year, chiefly in sewers and sidewalks for real estate developments.
Greencastle—Prospects good.
Huntington—Will be much less work than in 1915.
Lafayette—Prospects bright for big year in 1916, especially in sewers. No paving yet in prospect.
Laporte—Will have about five times as much work in 1916 as in 1915.
Logansport—Will be more sewer construction than last year. Other prospects not so good, as tax rate on streets under three-mile road law has been worked to its limit.
Princeton—Prospects for 1916 very good, especially in sanitary sewers.
Richmond—Will do a good amount, but not as much as in 1915, which was a banner year.
Union City—More construction of brick pavements in 1916.
Wabash—A little more work than in 1915 in streets and sewers.
Warsaw—More paving proposed for 1916.
Washington—Will do much more than for several years. More than is reported under sidewalks and curb and gutters.

Iowa—
Atlantic—Prospects are better for 1916. Are ahead of needs of city on sewers and water mains and spent $10,000 last year on light and water plant.
Burlington—Will probably not do as much work as last year. New council April 1.
Cedar Falls—About same as 1915.
Cedar Rapids—No work.
Centerville—Prospects good for much more sewer work and about same amount of paving as in 1915.
Cherokee—More paving, less sewers and water mains than in 1915.
Council Bluffs—Prospects not so good for 1916. "Town went dry."
Creston—More sewers and paving in 1916.
Ft. Madison—More paving.
Keokuk—Nothing decided until after April election.
Manchester—Prospects equal to 1915, but nothing decided yet. Will probably do four or five blocks of brick paving.
Maquoketa—"Loss of revenue from liquor licenses will greatly curtail improvements."
Marshalltown—More storm sewers.
Mason City—Will do $750,000 of public work in 1916.
Missouri Valley—Prospects better than for many years.
Pella—Well supplied with public improvements except paving. Will do some this year.
Sioux City—Fully equal to 1915.
Spencer—About same as 1915.
Washington—Not as much as in 1915.

Kansas—

Abilene—Increase in paving and water works improvements in this and neighboring cities and towns.
Arkansas City—Work looking better for all concerned. Will probably make more improvements than in 1915.
Atchison—Prospects better. Will do more paving.
Dodge City—About same as in 1915.
Fredonia—Prospects good for more paving than in 1915.
Great Bend—Prospects now about same as in 1915, but more paving is sure to follow.
Hutchinson—1916 will be a good year with more paving, business and residence building.
Iola—1916 will be a good year. Promotion of 20,00 more yards of pavement would be easy.
Lawrence—Paving about the same, sewer work double. $200,000 improvements in water works if bond election, March 14, carries, providing for purchase of plant.
Lyons—Prices for materials are so high that much contemplated work has been indefinitely postponed.
McPherson—Fully as much work as in 1915.
Neodesha—Will have more construction work, both public and private.
Ottawa—Not much paving in sight yet. More general construction work in other lines in prospect. Hands full of work same as last year.
Pittsburg—About same as 1915.
Rosedale—Expect to do more concrete paving than in 1915. Prospects for a very busy season.
Topeka—Will do twice as much paving as in 1915.
Weir—Will do 50 per cent. more good roads construction than in 1915.
Wellington—Will do more paving, storm water and sanitary sewers than in 1915.

Kentucky—

Carlisle—1916 will be about an average year.
Newport—1916 will be far ahead. $200,000 street work ready for letting in this and neighboring cities as against $60,000 in 1915.
Louisville—About same as 1915.
Paducah—Prospects much better than for 1915.
Paris—No plans for more than the usual necessary work.

Louisiana—

Kentwood—Little difference from 1915.
Patterson—Will do more road building and water connections.

Maine—

Bangor—Plans not yet made.
Gardiner—Plans not yet made.
Lewiston—Appropriations will be made in May. Work will be about the same as in 1915.
Saco—Election March 1. Plans made thereafter.
Van Buren—Expect to build considerable amount of streets and sidewalks, but appropriations are not made until last of March.

Maryland—

Cumberland—First election under new charter held in March. Public improvements can therefore not be predicted.
Frederick—About same as 1915; $30,000 a year maintenance and new streets and sewers.

Massachusetts—

Brookline—Appropriations not yet made.
Everett—Appropriations will be made in April and work laid out in May.
Great Barrington—Appropriations made March 27.
Greenfield—About same as 1915.
Haverhill—Appropriations not yet made.
Lawrence—Will do less than in 1915.
Malden—Appropriations not yet made.
Manchester—Prospects for municipal work excellent; for private work, poor.
Needham—Nothing definite until after March town meeting.
New Bedford—Will do more on both streets and sewers than in 1915.
Norwood—Will do more street paving than in 1915.
Orange—Will reduce tax rate.
Provincetown—About same as 1915.
Revere—Probably less than 1915.
Taunton—Appropriations not yet made.
Webster—Nothing definite until after annual meeting, last of March.
Westboro—About same as 1915.
Westfield—Appropriations made first Monday in April.
Winchester—Appropriations not yet reported.

Michigan—

Alpena—Changing to commission form of government this spring and prediction therefore difficult.
Ann Arbor—Will do less sanitary sewers; same storm sewers; more special construction.
Battle Creek—Will do more paving.
Benton Harbor—No program yet, on account of change in administration, April 1.
Detroit—Paving about the same; sidewalks, less; water works and sewers, more.
Dowagiac—New work not laid out until May 1.
Eaton Rapids—Prospects better than ever for paving and water works.
Flint—More work than ever before, due to rapid growth of city, requiring construction of nearly $1,000,000 worth of new factories and 3,000 new houses.
Grand Rapids—Not as much as last year. None of importance now in contemplation.
Greenville—About same as 1915.
Hastings—Appropriations made about June 1. Will do more paving.
Holland—More sewers, less paving.
Jackson—More than 1915.
Ludington—Prospects good; will probably do more in all lines.
Monroe—Petitions come in late, prediction therefore difficult.
Niles—No work laid out until after June 1, and organization of new council.
Onaway—Appropriations made May 1.
Petoskey—Prospects good. New city manager form to be installed in April.
Sault Ste. Marie—About same as 1915.

Minnesota—

Albert Lea—Will do more in paving and sewers.
Alexandria—Not as much as 1915. Nothing yet in sight.
Bemidji—More than in 1915.
Cloquet—Not as much as 1915.
Faribault—General prospects exceedingly good, especially for house construction. Public improvements about same each year.
Hibbing—Probably considerable paving, sidewalk and sewer work, but no plans made yet; $500,000 water system about completed.
St. Paul—Prospects very bright. Will do more work in all lines than 1915.
Sauk Center—Perhaps more than 1915.
Stillwater—Probably less than 1915, because of new council under new charter.
Thief River Falls—No work for for 1916 thus far.
Virginia—About same as 1915.
Willmar—About same as 1915 in sewers and water works.

Mississippi—

Vicksburg—May do more paving than 1915.

Missouri—

Columbia—About same as 1915.
Fulton—About same as 1915.
Independence—Paving, sidewalks, sewers, culverts, more than double 1915.
Jefferson City—Not as much as 1915. Petitions not yet in.
Kansas City—Special public improvements to be started in 1916 under $4,500,000 bond issue. Also $500,000 more regular assessed street and sewer improvement than in 1915.
Lexington—Not very good prospects.
Liberty—Prospects better. Bonds voted for sewers and more paving.
Pierce City—Not much to be done.
Poplar Bluff—Storm sewers principal work this year.
Sedalia—More paving and much more sewer work than 1915. Building will be less.
Webster Grove—Will do more construction work, particularly sewers, than in 1915.
Windsor—About same as 1915.

Montana—

Livingston—More paving contemplated, but not yet decided upon.
Miles City—Probably not as much as 1915, except in paving.

Nebraska—

Chadron—Better prospects for gravel streets, cement walks and curb.
College View—But little. Did large amount in 1915.
Gering—Better than any previous year.
Grand Island—Nothing definite until April 1.
Havelock—Will do more paving.
Lincoln—Will do much more than 1915.
Nebraska City—Not as much as 1915.
Red Cloud—About same as 1915.
Seward—More paving and water mains.
University Place—Will do something, not yet definite.

New Hampshire—

Laconia—Nothing definite. City election in March. Appropriations in May.

New Jersey—

Bayonne—Prospects good for paving. Probably 25 per cent. more than that listed.
Bloomfield—Prospects very good. Will do much work.
Bordentown—Will do some sidewalk work. Nothing else in prospect.
Cranford—Township about the same as 1915. Road appropriation, $15,000.
Elizabeth—More paving than 1915.
Glen Ridge—About the same as 1915.
Irvington—More than 1915, particularly large concrete storm drain.
Jersey City—May exceed 1915, except for scarcity of labor.
Long Branch—About the same as 1915.
Newark—Township will do three times as much as 1915 in paving, sewers and disposal plant.
New Brunswick—More than usual, particularly water works and paving.
Orange—Less than 1915.
Passaic—Less paving. Much more sewer work to adjust system to Passaic Valley main intercepting sewer.
Plainfield—Better than 1915.
Rahway—About same as 1915 in paving and sewers. Sewage disposal plant extra.
Ridgwood—Prospects better, particularly for permanent pavements.
Rutherford—Probably less than 1915.
Summit—May lay pavements, put in sewage disposal plant and pumps and storm sewer, but program not yet made.
Westfield—More than 1915 in sewers, if no scarcity of labor; $25,000 in park development.

New Mexico—

Albuquerque—Will start several large works this year.
Raton—Not as much as 1915, which was an exceptional year.

New York—

Albion—Prospects not as good as 1915.
Buffalo—About the same as 1915.
Carthage—Program not known until May. Probably same as 1915.
Dolgeville—Less sewers than 1915.
Dunkirk—Annual budget not available until April.
Ellenville—Same as 1915.
Elmira—Expect to issue $200,000 paving bonds later.
Geneva—Will not do 25 per cent. of 1915.
Glens Falls—Prospects much better, especially in water mains and street paving.
Gloversville—About the same as 1915.
Gouverneur—About the same as 1915.
Herkimer—No more than last year, unless water mains are laid.
Hornell—Program not yet available.
Hudson—More than 1915, especially in bituminous macadam.
Hudson Falls—About $3,000 for new work each year. Special work voted on in March.
Jamestown—Probably more paving.
Johnstown—Building prospects greatly increased.
Lackawanna—Not as much as 1915.
Little Falls—Paving indefinite on account of question about bond issue.
Lockport—Probably more construction, particularly buildings. Paving, sewer and water petitions not yet in.
Massena—No program yet on account of late eelction.
Niagara Falls—More than 1915 in sewers and water intersections.
Ogdensburg—Less than 1915.
Oswego—Paving about the same. Sewer construction, less.
Plattsburg—Plans not definitely decided, except as to $200,000 city hall and $250,000 memorial park to be started this spring.
Rensselaer—More work than 1915 in paving and school house construction.
Salamanca—About same as 1915.
Schenectady—Will do very little in 1916, owing to present high tax rate.
Utica—About same as 1915.
Watertown—About same as 1915.

North Carolina—

Burlington—Heavy expenditures: $50,000 to $100,000 for street paving, $30,000 for city hall, $38,000 for school houses, $65,000 for postoffice, $30,000 for office building.
Goldsboro—More improving of dirt streets will be done in 1916.

Greensboro—Prospects good. More sewer work, less paving.
Plymouth—Water works, sidewalks and sewers of 1916 are first public improvements to be made.
Rockymount—Most of the construction done in 1914 and 1915. No large work for 1916.
Wilmington—No work on hand except one gravel road.
Wilson—Water, gas and street improvements for 1916 amount to $410,000.

North Dakota—

Fargo—As good a year as they have ever had. As much paving and more sewer and water extensions.
Minot—As much or more than 1915.

Ohio—

Bellefontaine—Probably less than 1915.
Bucyrus—Probably ten times as much as in 1915
Chardon—None, except new water works system this year, because of recent completion of sewer system and sewage disposal plant
Chicago Junction—More than 1915.
Chillicothe—More street paving, less sewers.
Cincinnati—Council has not yet acted.
Conneaut—More paving.
Cuyahoga Falls—Much work in 1916. Completing street paving listed and more yet to be planned, three or four miles of trunck sewer with deep well excavation, seven to ten miles lateral sewers.
Dayton—Much more than 1915 in bridges, storm drains, sanitary lateral sewers, street paving.
Delaware—More in 1916, one or two streets not started yet.
East Palestine—Much more than 1915.
Fayette—About same as 1915.
Fostoria—Fewer contracts but more actual construction. Reservoir job larger than all 1915 work.
Greenville—More sewer work and less street work.
Lakewood—About same as 1915, $300,000, with $200,000 sewage disposal works additional.
Lancaster—About same as 1915.
Luna—More paving than any preceding year
London—Too early to estimate 1916 work.
Lorain—More than 1915.
Marietta—Prospects for work rather better than 1915; depend on new council.
Middletown—About same as 1915.
Newark—Probably no paving in 1916.
New Comerstown—More, by the sewers listed in this table.
Niles—Not as good prospects. But little sewers or paving, owing to advance in cost of labor.
Norwood—Will have unusually busy season if bond issue passes in April as expected.
Painesville—About same as 1915.
Steubenville—Much lighter improvements than for past nine years, as city's financial condition is not satisfactory.
Toronto—More paving than 1915.
Wapakoneta—More sewers, less paving.

Oklahoma—

Bartlesville—More paving and park improvement and garbage disposal.
Enid—Much more sewer and sidewalk work; also water works enlargement and main extensions and concrete bridges, if bond issues carry.
Holdenville—More paving, sewers and sidewalks than in 1915.
Okmulgee—More paving and bridges.

Oregon—

Astoria—Three times as much, mainly pavements, walks and viaducts.
Corvallis—Much better prospects than 1915. More street improvements, less water mains.
The Dalles—Very little in 1915.
Eugene—About same as 1915.
Klamath Falls—Probably very little in 1916.
Marshfield—Prospects much better, more paving, building and ship construction.
Pendleton—Will probably do some paving. Too early to estimate amount.
Portland—About same as 1915.
Salem—Probably more than 1915, but amount not yet certain.

Pennsylvania—

Altoona—More than 1915.
Bethlehem—Over six times as much paving as usual.
Bloomsburg—No action yet.
Blossburg—Less than 1915; no paving.
Carlisle—Less than 1915.
DuQuesne—General conditions better, but no provisions yet for public improvements.
Franklin—About same as 1915.
Freeport—Prospects better for street and sewer improvements.
Lock Haven—Nothing decided yet.
McKeesport—Local prospects not good.
Meadville—About same as 1915, $10,000 for city's share. If bond issue is passed, will spend $50,000 to $75,000 more in 1916, for paving and storm sewers.
Miners Mills—About same as 1915. Appropriations not yet made.
New Brighton—Plans not yet made.
Norristown—Much more than 1915.
Northampton—More concrete road construction than 1915.
North Braddock—About same as 1915, unless large storm sewer gets started.
Oil City—Probably much less than for ten or twelve years.
Portage—More street paving and sanitary sewers.
Rankin—Prospects very bright for more construction work in all lines.
Ridgway—Less in 1916 on account of large improvements during past three years.
Scottdale—Will be less paving unless bond issue should be decided on.
Waynesboro—More paving than 1915.
Williamsport—Program not yet decided on.
Wilkes Barre—Less than 1915.

Rhode Island—

Pawtucket—No plans yet.
Woonsocket—Much more street work than 1915.

South Carolina—

Bennettsville—Prospect good for general extensions and good business this year.
Charleston—Paving schedule not yet prepared.
Columbia—More sewer and water extensions, less street and sidewalk paving.
Sumter—None in 1915; $225,000 in 1916.

South Dakota—

Aberdeen—Not much public work anticipated. Prospects good generally.
Huron—Good increase over last year.
Mitchell—More paving; perhaps less sewer and water main construction.
Sioux Falls—More paving; same sewer expenditure; less water works improvement.
Yankton—More than in 1915, tho prices will be about 25 per cent. higher.

Tennessee—

Bristol—More streets and sidewalks than 1916; also reservoir and $60,000 high school.
Dyersburg—More street and alley paving, sewers, water mains, electric light extensions.
Fayetteville—Street plans not yet made.
Newport—More than 1915.
Paris—About same as 1915, city work. General prospects better.

Texas—

Greenville—About same as 1915.
Longview—Prospects better; more paving.
Orange—Will spend $150,000 on slips and docks.
Paris—About same as 1915.
Sulphur Springs—City less, but county much more than 1915.
Waxahachie—More sanitary sewers and water mains; less paving.

Utah—

Ogden—Less than 1915.
Provo—Probably more sidewalks, but less street paving. Program not yet complete.

Virginia—

Danville—Appropriations made May 1.
Harrisonburg—About same as 1915.
Staunton—Probably greater total.

Washington—

Camas—Improvements in the district very light for 1916.
Grandview—Conditions better, but very little public work in sight for 1916.
South Bend—Prospects better, but no city work for 1916; more private and county work.
Tenino—First six months not very promising. If lumber industry revives last half, better prospects.
Vancouver—Prospects poor for anything but necessities.
Walla Walla—Considerable more than 1915.

West Virginia—

Charleston—About the same paving as 1915. No sewers.
Moundsville—About same as 1915.
Parkersburg—Will lay about twelve times as much paving in 1916 as in 1915.
Wheeling—Plans not yet made.

Wisconsin—

Antigo—Water department, more work than in 1915. Other public improvements delayed by replacing of burned high school.
Appleton—Much lighter than 1915.
Ashland—Prospects good. Program not yet completed.
Beloit—Same as 1915 with additional bridge work.
Chippewa Falls—Not as much as 1915.
Eau Claire—Less in all lines.
Janesville—About the same as 1915.
La Crosse—Less than 1915.
Madison—About same as 1915.
Manitowoc—More paving and building in 1916.
Marshfield—About same as 1915
Menasha—More street work in 1916.
Oshkosh—About same as 1915.
Pt. Washington—Program not made until May 1.
Racine—More paving, less sewers.
Waukesha—About same as 1915.
West Allis—Too early to make estimate. Probably much more paving, less sewer and water work.

Wyoming—

Laramie—More paving, less other work.

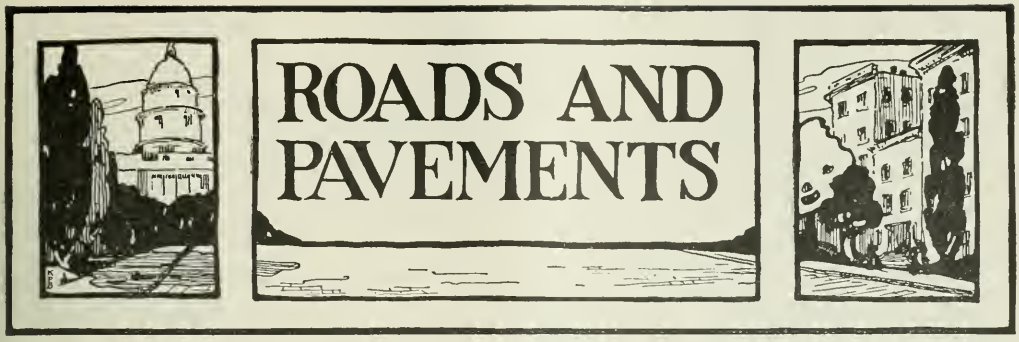
CANADA—

Alberta—

Calgary—Not so large in 1916.

Ontario—

Hamilton—Owing to the war, will do as little construction work as possible.
Ottawa—Owing to the war, will do as little construction work as possible.
Regina—Complete program not yet determined. Probably about same as 1915.
St. Catherines—Prospects better than 1915.
Stratford—Labor market will control amount of work. Otherwise prospects good.



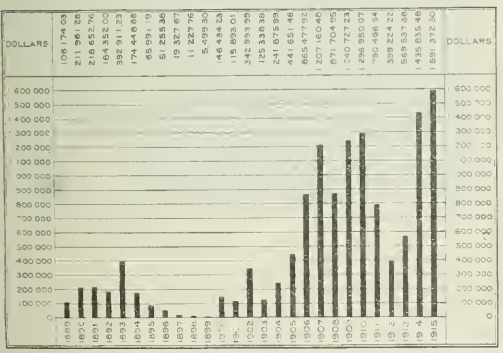
Municipal Improvements in Salt Lake City

The diagram shown here is from the annual report of the city engineer of Salt Lake City, Utah, just completed. It illustrates in graphic style the story of public improvements in Salt Lake during 1915, as compared to the records of other years.

As the engineer observes in his report, and as the diagram plainly indicates, the year 1915 witnessed more extensive public improvements in Salt Lake than any previous year in its history. In addition to the $1,591,372.30 actually expended, other contracts were let, but not completed in 1915, amounting to $347,014.39, bringing the total cost of public improvements completed and undertaken during the year close to the two million dollar mark.

The improvement program included 66.5 miles of sewers, practically one-third of the entire sewage mileage previously laid, including the great outlet sewer now in process of con-

DIAGRAM SHOWING COST OF PUBLIC IMPROVEMENTS.



struction; the great storage reservoirs in Big Cottonwood canyon, the Fifth South street and the City Creek equalizing reservoirs and additional supply and distributing mains; six and three-tenths miles of pavement, nearly five miles of curb and guttering, and nearly nine miles of sidewalks.

The extent, cost and nature of public improvements during the year are shown in the following statement:

1.823	miles of water supply mains	$ 33,501.00
9.969	miles of distributing mains	67,183.00
2.825	miles of bitulithic pavement	132,051.72
0.688	miles of bituminous concrete pavement	33,756.77
0.300	miles of sheet asphalt pavement	14,445.61
2.402	miles of Utah rock asphalt pavement	170,153.62
0.108	miles of concrete pavement	3,848.12
8.854	miles of cement sidewalks	28,444.78
4.881	miles of curb and gutter	71,446.23
7.293	miles of sewer mains	318,544.45
59.258	miles of sewer laterals	520,462.56
1.066	miles of storm sewers	14,530.55

Treatment of Wood Paving Blocks at the Consumer's Point

The market for wood block paving has been amazingly increased by a new type of treating plant which by its simplicity makes it possible to treat the blocks near the consuming point, thus cutting the freight rates which had previously added materially to the cost of the superior wooden block paving in many parts of the country. The new type of treating plant is a vertical cylinder, which can be adapted to handling other material than wooden blocks, and so be used to treat material for the retail trade, such as the smaller dimension timber, silo stock, bridge material and farm timbers.

, The new type of cylinder, developed by two engineers working separately along similar lines, J. B. Card, of Chicago, and G. B. Shipley, of Pittsburgh, has as its chief advantage its low first cost and its simplicity of operation. Only two machines are required, with much smaller tanks and cylinders, thus permitting the construction of paving block plants in connection with saw mills or near consuming points. Freight rates on shipments of blocks to remote territory may thus be eliminated, making it easier to meet the competition of other paving materials. In many localities the cost of wood block has been high, owing to the long freight haul. The new treating method appears to meet this difficulty, and will thus make possible the use of southern pine in the south, tamarack in the north, and fir on the Pacific Coast, or any other wood suitable for pavement.

Good Roads Notes

Of 300 miles of pavement in Columbus, O., 193 are of vitrified brick.

Increase of business outside the city by 65 per cent. on account of motor-truck delivery is reported by the Globe Furniture Co., of Fond du Lac, Wis., some deliveries being made as far as 45 miles from town. This is an indication of the enormous use which will be made of motor trucks for carrying products from the farm and purchases back to the farm as well as to other customers, which will develop just as fast as the roads become good enough to stand the strain. The Kissel-Kar truck shows its ability to stand the strain even when the roads are not the best, by means of such reports as the above.

FIRE DEPARTMENT

Progress in Fire Motorization

The city of Youngstown, O., has nineteen pieces of motor fire apparatus in service, covering four makes. Chief Joseph Wallace submits the following costs, covering one piece, as typical:

Period of time—From January 1, 1915, to January 1, 1916.
Type of motor fire apparatus—Triple combination.
Name of make—Knox.

Cost of repairs, including labor and material	$162.60
Cost of gallons of gasoline	45.65
Cost of gallons of oil	4.00
Cost of gallons of grease	1.75
Miscellaneous expense, batteries recharged	7.20
Total cost	$221.20
Distance traveled (miles)	696
Number of alarms answered	253

Youngstown has had no horses in its fire department for the past two years.

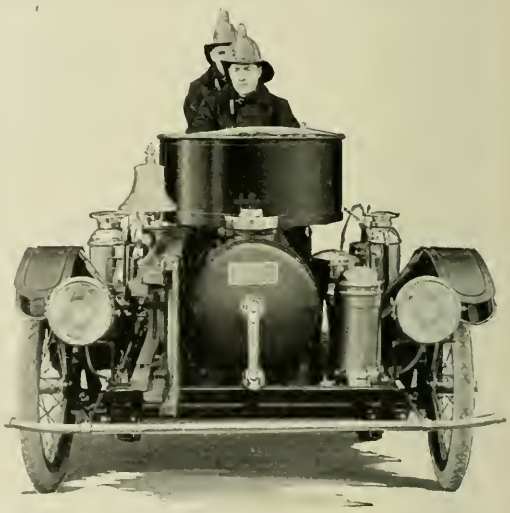
Do Away With Twelve Horses.

T. C. Collins, chief engineer, fire department, Cohoes, N. Y., states:

"We have four pieces, all placed in service February 1, 1915: A triple combination with 800-gallon pump, a combination chemical and hose wagon, a 4-wheeled tractor attached to a 75-foot aerial truck and a 2-wheeled tractor attached to a second size Metropolitan engine. These four machines take the place of 12 horses and we find that it costs us approximately 75 cents a day per horse, or $9.00 for the twelve, or $3,285 for the year. Our total expense for the care of the four motors for the year ending February 29, was $311.14. This includes gasoline, oil, grease and such minor repairs as became necessary."

Low Cost Per Mile.

"The city of St. Cloud, Minn.," states Chief L. A. Moosbrugger, "expended the sum of $14.53 on its motor fire apparatus in the year 1915. Our truck covered 113.6 miles in going to fires and 10.03 in practice runs. In fire runs 90 gallons of gasoline and 4.6 gallons of oil were used at a cost of $13.17, while the practice runs cost $1.36, making a total of $14.53."

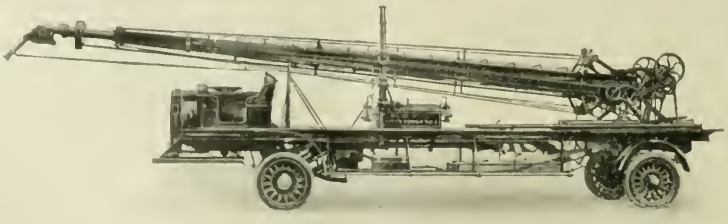


Dayton Tri-Car Chemical.

Turns River Into Fire-Fighting Stream.

Power of the White fire apparatus owned by East Machias, Me., to convert water from a river into a powerful and steady stream despite hills or lifts up which hose must be laid was recently demonstrated.

Hose was dropped from a bridge to the water level, making



American La France Water Tower.

a lift of 20 feet. The nozzle was a one and one-quarter. The engine started and the draft was perfect, throwing 508 gallons a minute.

On another occasion water had to be drawn from the river to the top of a hill about a half mile away. The apparatus overcame the conditions and threw a solid stream. Needless to say East Machias has put faith in this machine and feels certain that it is equal to any emergency that may arise.

More Mileage at Less Cost.

Chief Nathan Bradfield, La Crosse, Wis., submits the following table covering costs of motor combination hose and chemical as compared with similar horse-drawn outfit. In answering thirty-seven alarms, the motor-driven outfit traveled 103.3 miles, while, in answering twenty-three alarms, the horse-drawn apparatus traveled 50.2 miles:

AUTO APPARATUS.

95 gallons gasoline	$ 10.55
6 gallons oil	1.76
5 gallons grease	.60
1 can 3-in-1	.25
Total	$ 13.16

HORSE-DRAWN TRUCK.

Feed	$ 74.21
Shoes	27.60
Harness repairs	.60
Total	$102.41

Big Saving Over Horse Equipment.

According to figures compiled by Chief William E. Markwith, East Orange, N. J., which has a population of 34,371, according to the 1910 census, the motor apparatus now in use represents a saving for 1915 over the cost of maintaining horse equipment of $1,681.51.

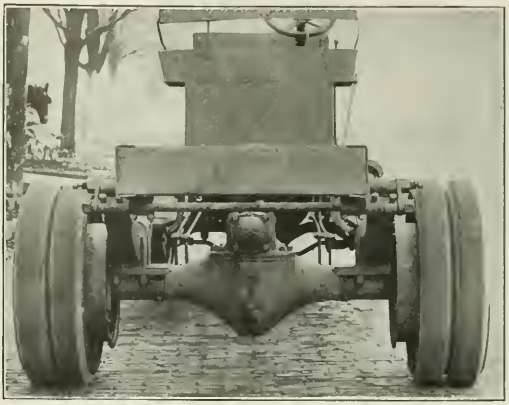
The records show that the chief's automobile covered 2,448 miles during the year at a cost of $118.74. As it would have cost $17.60 a month to keep a horse, or $211.20 for the year, the saving was $92.46. The mileage of the White motor truck for the same period was given as 269½, at a cost of $52.97, whereas the maintenance of three horses would have amounted to $633.60, and thus the saving was shown to be $580.63.

The White Motor Chemical No. 5 covered 204.2 miles and cost $22.72 for maintenance which, deducted from the cost of keeping three horses, gave a saving of $610.88. Motor Chemical No. 5, which traveled 329.8 miles in the year, cost $24.86, against the maintenance of two horses amounting to $422.40, and was, therefore, credited with a saving of $397.54.

A Concord, N. H., Record.

Chief Green of the Concord, N. H., fire department has compiled some figures showing the cost of motor-driven and horse-drawn fire apparatus, which are decidedly interesting.

The figures cover the cost for the year ending January 1, and in order to be strictly fair, the Chief says: "It should be borne in mind that the presence of an epidemic during the last three months of the year among the horses made the maintenance expensive, while the fact that the machine, being new,



Rear View South Bend Tractor.

required no very extensive repairs, militated to the advantage of the same. But with both of these factors eliminated, the margin in favor of the auto appears to be too large to admit of further doubt as to which can be used to advantage. Aside from the financial saving, the saving in time in responding to alarms, an important feature, should be given full consideration.

"It cost to maintain the fifteen horses in the department for the year $2,592.58, $1,801.48 of which was for forage and $298.70 veterinary bills. The cost per horse was $172.84. The cost of transporting each two-horse piece of apparatus was $345.68, and of the three-horse trucks, $518.52. The cost of transporting the motor was $90.17.

"The Robinson combination traveled 542 miles on 252 gallons of gasoline, 17 gallons of oil and 100 pounds of grease. The materials used at fires were 734 pounds of soda, at two cents per pound, 434 pounds of vitriol, at three cents a pound, and 274 pony extinguisher bottles, at seven cents each, making a total cost of $46.88, and bringing the total cost of the operation of the motor to $137.05."

Urbana, Ill., Costs.

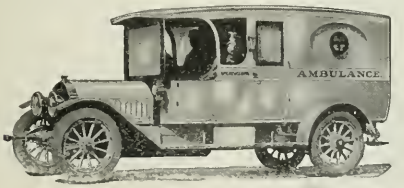
The property of the fire department, Urbana, Ill., consists of two Seagrave motor combinations, chief's auto, horse-drawn ladder truck and four horses. The department contains five men, including the chief. Following appear the motor and horse-drawn costs of this department for a period of twelve months:

HORSE-DRAWN.

Feed and bedding	$288.05
Horseshoeing	33.75
Repairs	5.10
Total	$326.90

MOTOR DRIVEN.

Gasoline	$ 12.75
Engine oil	2.63



Typical Kissel Patrol and Fire Apparatus Installations.

Prest-O-Lite	8.00
Dry cells	2.00
Repairs	1.50
Total	$ 26.80

CHIEF'S CAR.

Gasoline	$ 18.42
Engine oil	5.27
Dry cells	6.00
Repairs	28.50
Total	$ 57.91

Norwich, Conn., Test

The following figures cover results of test, of a Seagrave Pumper, submitted by Chief H. L. Stanton, Norwich, Conn.:

Engine—6 cylinder, $5\frac{3}{4}$ x $6\frac{1}{2}$.

Pump—4 stage centrifugal.

Gear Ratio—Engine to pump—1 to 2.06.

Contract Requirements: 750 gallons a minute at 120 pounds net pump pressure; 600 gallons a minute at 160 pounds net pump pressure; 450 gallons a minute at 200 pounds net pump pressure; 375 gallons a minute at 250 pounds net pump pressure; 150 gallons a minute at 350 pounds net pump pressure.

Tested at: Draft from river.

Life: 7.7 to 9.6 feet.

First Test—Duration: 30 minutes. Layout of hose and nozzles: One line of $2\frac{1}{2}$-inch hose, 300 feet; 1-inch nozzle. Average discharge and pressure: 413 gallons at 265 pounds net pump pressure. Remarks: Satisfactory.

Second Test—Duration: 30 minutes. Layout of hose and nozzles: One line of $2\frac{1}{2}$-inch hose, 150 feet; $1\frac{1}{4}$-inch nozzle. Average discharge and pressure: 517 gallons at 211 pounds net pump pressure. Remarks: Satisfactory.

Third Test—Duration: 2 hours. Layout of hose and nozzles: Two lines of $2\frac{1}{2}$-inch hose, 100 and 150 feet; $1\frac{3}{4}$-inch nozzles. Average discharge and pressure: 774 gallons at 127 pounds net pump pressure. Remarks: Satisfactory.

Fourth Test—Duration: 6 minutes. Layout of hose and nozzles: Two lines of $2\frac{1}{2}$-inch hose, each 250 feet; $1\frac{1}{2}$-inch nozzle. Average discharge and pressure: 638 gallons at 173 pounds net pump pressure. Remarks: Satisfactory.

Fifth Test—Duration: 5 minutes. Layout of hose and nozzles: One line of $2\frac{1}{2}$-inch hose, 700 feet; 1-inch nozzle and discharge gate partly closed. Average discharge and pressure: 150 gallons at 360 pounds net pump pressure. Remarks: Satisfactory.

General Remarks: Satisfactory.

Advocating Pulmotor Car

Many prominent fire engineers are advocating a pulmotor car. In other words, it is being quite strenuously recommended in many quarters that an up-to-date pulmotor be kept in the chief's or first assistant chief's motor car for emergency purposes.

Arthur S. August, fire chief, East Liverpool, Ohio, submits the following pulmotor runs answered by the chief's car:

May 16, 12:02, Alton and Hubbard Sts., electric shock received by Edgar Vess, 11 years old, used pulmotor 5 minutes, saved boy's life.

May 21, Newell, W. Va., drowning and shock, Mrs. Susie Clynoggle jumped from bridge, death was caused by jump, used pulmotor 45 minutes, no results.

July 12, Fredericktown, drowning, Miss Katherine Martin, in water 4 hours, pulmotor used 2 hours, no results.

July 22, Dresden Ave., shock by telephone wire. Little girl, name not learned, did not use pulmotor.

August 4, Seventh and Monroe, cave-in, name unknown, revived without using pulmotor.

August 9, Wellsville, O., drowning, name unknown, could not find body, did not use pulmotor.

September 23, West Eighth St., heart failure, lady unknown, used pulmotor 40 minutes, no results.

September 25, Pennsylvania Ave., automobile accident, name unknown, did not use pulmotor.

September 4, Erie St., heart failure, E. Robinette, pulmotor used 45 minutes without results.

December 6, Gardendale, drowning, Edgar Davis, used pulmotor 10 minutes and saved boy's life.

As will be seen, two lives were saved by the use of the pulmotor. In most of the cases the time that elapsed before calling or persons being in the water was too long, but the pulmotor was used so that there would be no doubt.

Stands Severe Test Nine and a Half Hours

No motor fire apparatus ever received a more severe test than that given the New Bedford, Mass., equipment at the recent Fall River fire. The fire attacked the business district and threatened the city with disaster. Fire Chief Edward F. Dahill, of New Bedford, was among the first to offer the service of fire fighters from neighboring municipalities. Shortly after midnight he gave the order to his men to hurry to Fall River. The roads were covered with ice and snow. The sky, by its wide area of reddish hue, indicated that the flames were spreading. The firemen realized that the motor apparatus had the battle of its career ahead.

The apparatus, a combination chemical and pumping engine, built by the White Company, of Cleveland, at thirteen minutes past midnight, left its station and thirty-seven minutes later was connected to a hydrant at Main and Anawan streets, Fall River. Credit has been given the New Bedford firemen for stopping the conflagration on the east side of South Main street and for helping save St. Mary's Cathedral. Chief Dahill and his men stayed on the job until 6 o'clock, and at the end of that time the White machine had pumped steadily for $9\frac{1}{2}$ hours. How it stood this pumping test, how it stood the bad road test, is best told by Captain James Mahoney in an interview given the newspapers after the fire.

"The roads were icy, but the trip from New Bedford to Fall River was made without incident, the big machine holding the road well. No motor apparatus was ever asked to take the road under more unfavorable winter road conditions. We arrived in record time, considering conditions, and went to work at once. For $9\frac{1}{2}$ hours the White engine pumped and not once was there even the slightest trace of a skip. This showing not only demonstrates the power and efficiency of the engine, but also reflects creditably on the care the apparatus receives. We went home tired but happy and mighty proud of our apparatus."

Henry Mayer, fire marshal of Bloomington, Ill., joined the fire department as a call man in 1881. He was promoted to be engineer of a chemical engine in 1887 and to be chief in 1895, so that he is now serving his twenty-first year in that position. He has seen one conflagration due largely to the lack of proper water distribution system, and the small horse-drawn department of the time before the fire has become a modern, up-to-date motorized department of high efficiency.

MISCELLANEOUS

The March of Events

April 12, Portsmouth, O. The Institute of Paving Brick Manufacturers. W. G. D. Orr, chairman of program committee.

April 19 to 22, at New York City. First National Conference on Community Centers and Related Problems. John Collier, secretary, 70 5th Avenue, New York.

April 18 to 21, at University of Illinois, Urbana, Ill. The American Chemical Society will meet and hear final report on methods of analysis of sewage and water and discuss activated sludge.

May 2, 3, at Park Hotel, Williamsport, Pa. Pennsylvania State Chiefs of Police. Geo. W. Harder, secretary, Williamsport, Pa.

May 8 to 10, at Waco, Tex. Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Tex.

May 9, 10, 11, at Auditorium of Insurance Exchange, Jackson and La Salle Sts., Chicago, Ill. Annual meeting of National Fire Protection Association. Franklin H. Wentworth, secretary, 87 Milk St., Boston, Mass.

May 10 to 17, at Indianapolis, Ind. National Conference of Charities and Corrections. Central office, 315 Plymouth Court, Chicago, Ill.

May 31 to June 2, at Syracuse, N. Y. New York State Conference of Mayors. Mark E. Conan, comptroller, Syracuse.

May 31 to June 2, at Syracuse, N. Y. National Association of Comptrollers and Accounting Officers.

June 4 to 8, at New York City. American Water Works Association. J. M. Diven, secretary, 47 State St., Troy, N. Y.

June 15, 16, at Cleveland, O. Ohio Society of Mechanical, Steam and Electrical Engineers. Joseph L. Skelton, president, Toledo, O.

June 28 to 30, at Battle Creek, Mich. Michigan League of Municipalities.

July 9 to 13, at Detroit, Mich. Wold's Salesmanship Congress. Walter C. Cole, secretary, Board of Commerce Bldg., Detroit, Mich.

July 11 to 13, at Goshen, Ind. Municipal League of Indiana.

August 7 to 9, at Houston, Tex. City Marshals' and Police Chiefs' Union of Texas.

September 6 to 9, at Newark, N. J. League of American Municipalities.

September 13 to 15, at Portland, Me. Convention of New England Water Works Association. Willard Kent, secretary, Narragansett Pier, R. I.

October 9 to 13, at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Bldg., Indianapolis, Ind.

October 16 to 21, at Detroit, Mich. National Safety Council holds its annual safety congess. W. H. Cameron, secretary, Continental and Commercial Bank Bldg., Chicago, Ill.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

April 12, 13: Computer and Estimator, in office of Supervising Architect, Treasury Dept., at $1,600 a year.

April 12: Junior Engineer, in Engineer Department, War Department.

April 18: Assistant Petroleum Engineer, Bureau of Mines, for service in field, at $1,800 to $2,500 a year.

April 18: Engineer Economist, in Office of Public Roads and Rural Engineering, at $2,000 to 2,500 a year.

April 18: Mechanical and Electrical Inspector, at Naval Proving Grounds, Indian Head, Md., at $6.72 a day.

April 19: Junior Signal Engineer and Junior Structural Engineer, under Interstate Commerce Commission on railroad valuation, at $1,200 to $1,680, and $720 to $1,080 a year.

April 25: Electrical Draftsman, in Bureau of Steam Engineering, Navy Department, at $5.04 a day.

May 2: Mechanical Superintendent in Department of Agriculture, Washington, D. C., at $2,500 a year.

May 2: Associate Engineer Physicist, in Bureau of Standards Department of Commerce, at Washington or Pittsburgh, at $2,000 to $3,000 a year.

May 3: Laboratorian qualified in electrical science, in Mare Island navy yard, Cal., at $3.60 a day.

August 21 to 25: Second Lieutenant from civil life, from those qualified as junior engineers, Engineer Department, War Department.

The Philadelphia, Pa., Civil Service Commission will hold examinations as follows.

April 17 to 20: Draftsmen, City Transit Department, bridge division, $600 to $1,200 a year.

April 26: Tracer, City Transit Department, $600 a year.

May 3: Transitman, City Transit Department, 1,200 to 1,500 a year.

May 4, 5: Assistant Engineer, Surveys Bureau, Department of Public Works, at 2,500 a year; also Structural Draftsman, at $1,200 to $1,500 a year.

Technical Organizations

The American Association of Engineers is growing rapidly its membership now being 500. Its employment bureau shows great activity and, at last report, had thirty unfilled positions

at salaries of $1,200 to $5,000 a year and only four of its members unemployed.

The National Americanization Committee, 18 W. 34th St., New York City, has instituted a competition for workmen's houses under four problems, each of which has a first prize of $300 and a second prize of $100, with an additional prize of $200 for excellence of construction. Drawings must be delivered at the office of the committee before noon on June 1. Full particulars will be given on request by the secretary. There is also a competition for plans for a substitute for the derailed freight car now used to house railroad construction gangs, with prizes totaling $600.

The New Hampshire Good Roads Association has been organized with Ovid F. Winslow, Nashua, N. H., as president, George P. Winn, Nashua, as secretary, and a full list of vice-presidents and directors.

Technical Schools

Highway Bulletin No. 1 of Purdue Univ., Lafayette, Ind., is on the maintenance of Indiana Highways, by Geo. E. Martin, C. E., assistant professor of highway engineering in the School of Civil Engineering.

"Smoke Abatement" is the title of a bulletin of Purdue University, by C. H. Benjamin, dean of the Schools of Engineering.

The catalog of Worcester Polytechnic Institute, Worcester, Mass., gives full descriptions of facilities and courses and a register of graduates. Ira N. Hollis, Pres.

Columbia University will hereafter confer the degree of Master of Science upon graduate engineering students who satisfactorily complete the Graduate Course in Highway Engineering. From 1911 to 1915, the graduate engineering students who have specialized in highway engineering have been candidates for the degree of Master of Arts.

The announcements of the Division of Chemistry, Columbia Univ., New York, for 1916-17 are included in a recent bulletin of the university.

Supply Department Recommended for Boston

The Boston Finance Commission has recommended that the supply department of Boston be enlarged so as to include the purchases of all departments. This follows an investigation into floor preservatives used by the several departments, involving charges that the materials were charged for at excessive prices and were not of standard quality.

Milford Will Not Purchase Lighting Plant

A committee, for which William Plattner acted as consulting engineer, reported recently upon the purchase of the plant of the Milford Electric Light and Power Co. The result of the report was an offer of the company to make a more advantageous contract with the town for lighting it with modern lights, and on recommendation of the committee and Mr. Plattner the town meeting of March 20, voted the committee authority to make a contract with the company for from two to five years on the new terms.

Personal Notes

Paul Hansen is now in charge of the Engineering Bureau of the Illinois State Board of Health at Springfield. He was recently with the State Water Survey at Urbana and before that was connected with the state health departments of Kentucky and Ohio.

Sylvester Q. Cannon has been reappointed city engineer of Salt Lake City, Utah, under the new commission form of government.

B. C. Brennan is re-elected for the fourth term as city engineer of Kenosha, Wis.

John L. Collins, consulting engineer, New York, will supervise plans and construction of sewers and sewage disposal plant for Sussex, N. J.

Ernest McCullough, consulting engineer, Chicago, is the chief engineer of the fireproof construction bureau of the American Association of Portland Cement Manufacturers.

Joseph P. Bayne, who has been in the employment of the engineering department of Cleveland, O., for thirty years, has resigned to take charge of the paving department of the Cleveland Railway Co. He began as rodman and moved up to the head of the paving department, which position he has occupied since 1899. From a city with a few main thorofares paved with Medina stone, he has had a large share in developing 556 miles of paving, 420 miles of which are of brick. F. W. Williams is his successor in the city paving department.

Max Harris Wilensky has opened offices in the Bailey Bldg., Philadelphia, Pa., for the practice of law.

Daniel W. Mead and F. W. Scheidenhelm have opened offices as consulting engineers on hydraulic and electric developments, water supply and reclamation works, in the Equitable Bldg., 120 Broadway, New York.

J. W. Mercer has been appointed county engineer of Lucas county, Iowa.

Harold Bargeman has been appointed county engineer of Maricopa county, Arizona.

Ray Vosler, formerly city engineer of Greenville, Pa., is now with the Carnegie Steel Co., at Youngstown, O.

Frank E. Weymouth is the new chief of construction of the U. S. Reclamation Service. He has been a part of the Reclamation Service organization since 1902.

Publications Received

"Water Purification Plants and Their Operation," by Milton F. Stein, assistant engineer of design, Cleveland filtration plant, is a manual primarily for operators of water purification plants, also of interest to water works chemists and engineers, containing instructions for making chemical and bacterial tests, handling coagulants, washing filters and keeping records, with chapters on the processes of coagulation, sterilization, water softening and sedimentation, and descriptions of existing plants and useful charts for solving graphically problems relating to chemical tests and the application of coagulants; $2.50, net. John Wiley & Sons, New York.

A "Comprehensive Plan of Newark" is presented by the City Plan Commission of Newark, N. J., who had the aid of George B. Ford and E. P. Goodrich, expert architectural and engineering advisers, a number of architects and publicists on special investigations and the officials of the engineering, construction and health departments of the city. The report is the most suggestive yet published and is worthy of close study by those interested in the preparation of similar reports.

A report on market system for New York City and open markets established in Manhattan is issued by Marcus M. Marks, president of the boro of Manhattan and chairman of the committee on markets of the board of estimate and apportionment. In addition to the report about the open markets established in Manhattan and the results therefrom, there is a brief report of an open market in the boro of Richmond. Various persons report on the market conditions in Paris, London, Berlin, Hamburg and Cologne, giving in the German report regulations, forms of price lists, schedules of charges, rules for auctioneers, etc.

"West Point in Our Next War" is the title of a book, with a sub-title, claiming that the only way to create and to maintain an army is set forth in it. The author is Maxwell Van Zandt Woodhull, A. M., late Lt-Col. and Asst. Adj.-Gen., 15th Army Corps and Army of the Tennessee, Bvt. Brig.-Gen., U. S. V. The publisher is G. P. Putnam's Sons, New York, and the price is $1.35 by mail.

MACHINERY AND SUPPLIES

How a Contractor Handles State Highway Work

By D. G. Bevis, C. E.

On certain types of roads the equipment used and the methods of construction gradually become standardized. Nevertheless, a modern highway construction plant and the method of handling the work economically depend very largely upon the conditions encountered. While the concrete highways which have been built by the state of California and several of the counties during the last few years have in general followed the same specifications, the conditions confronting the contractor have varied widely. Two given contracts of approximately the same mileage may require totally different methods of handling the work, depending upon the amount and character of excavation, soil conditions affecting shaping the roadbed and keeping it in condition for receiving the pavement, length of haul of materials and character of the soil over which it must be hauled, water conditions, etc.

On their 10-mile state highway contract for cement-concrete pavement in Tulare county, the contractors, White & Gaskill, of Long Beach, have, after careful investigation of the conditions affecting handling the work, put in a modern and complete equipment plant, which they have found to be both economical and best adapted to the quick handling and transportation of their materials.

This contract called for 30,000 tons of material to be transported an average haul of 1¾ miles. The country over which it was to be hauled was level but the soil was found to be very difficult to haul over by wagons and the us eof trucks was discovered impossible. It is also such that no hauling by wagons could be done after a rain until the ground had thoroly dried out. The sub-grade would cut up too freely under a team load.

On previous contracts these contractors had been using standard methods as practiced in California and were thoroly familiar with the advantages of the motor truck and dump wagon, which in hauling have become standardized. But the conditions confronting them on this contract were such that they were not satisfied with the hauling methods with which they were familiar. They made a careful survey of the methods employed by eastern contractors and found that the portable railroad was taking the lead and was being generally used by the most successful contractors of the east. Altho they were confronted by the fact that they did not have the large tonnage which they found in most cases where railroad equipment had been used, after careful consideration they decided that the purchase of a portable railroad would be both economical on this contract and a good investment in equipment for future operations. Their order was placed with the F. F. Foster Co., Inc., for a "Lakewood System."

The hauling plant being used consists of more than four miles of 20-pound, 24-inch-gage sectional track; twenty-one 2½-cubic-yard-capacity Lakewood "V" dump cars, together with the necessary switches and curved sections. To this they added a 5-ton gasoline locomotive to displace teams for power. This locomotive is a German make known as "Otto." It had been purchased several years ago by an amusement company whose project never materialized, and the locomotive has since been in storage. It was purchased much under the original cost to the first purchasers. It has only one cylinder and is rated at 12-h.p., yet it is said to be doing the work of a 35-h.p. ordinary engine. It hauls a load of fourteen cars, aggregating 33 tons, at 5 miles per hour, and makes a speed of 10 miles per hour with the train without load.

The material is being shoveled directly into the cars, which are set alongside the steam railroad siding. On account of several sharp curves and heavy grades and their having had to go thrû a culvert under the steam railroad, it was decided to use a team to haul the cars around onto the straight-away main line. The team haul is about 2,000 feet. After the first 4-mile section is completed, the teams will be eliminated, as the locomotive will haul directly from the switch. The team is now also picking up the empties and places them at the siding. One team will handle each eight hours 142 tons over this haul of 2,000 feet without difficulty. The contractors expect soon to be taking the sand from a pit instead of shipping it in. In this case it will be loaded over a trap by slip scrapers directly into the cars. These cars will be picked up by the team and placed upon the main line.

From the main line siding the gasoline locomotive takes fourteen cars to a trip, hauling the same to be dumped upon the sub-grade. The locomotive will handle 142 tons each eight hours on a haul of three miles.

The shoulders are made while the rough grading is done. The portable track is laid upon the shoulders just far enough from the headers so that the cars will dump upon the sub-grade.

One man, called the material man, takes care of the spacing of the material and can dump a car without assistance. While he is not busy on this, he is used on the sub-grade, which is rolled by an Austin gasoline road roller.

Since it is necessary to have 125 yards of material or more for each day's run of the No. 10 Chicago paver, they are compelled to work overtime on this work. The paver averages about 700 linear feet of pavement per day. However, this may be changed in the future and teams used to pull the cars to make the capacity sufficient in an 8-hour shift. One team of "4 Up" will handle ten 1½-yard cars on this contract, as it is a straight track without grades.

The great saving, aside from the great reduction in cost per ton-mile, of the "Lakewood System" over the team or truck haul, are of two varieties. First, after the sub-grade is made there is not a load hauled over it. It is never disturbed. This makes a saving of $250 per mile. Second, the hauling can

progress even during a rain. It is never necessary to stop on account of wet ground. This saving depends upon how much the contractor is pressed for time.

A transportation superintendent has complete charge of the railroad and the alinement of the track.

The costs of these various men and operations are as follows:

The cost per mile of hauling and laying the rail was about $90.

The track foreman is paid $5 per day, the locomotive engineer $4 per day, and the material man $4, helper $2.

The cost of the railway equipment, including the gasoline locomotive, was $14,000.

The team hauling from the switch cost $4 per day.

The gasoline locomotive consumes 12 gallons of distillate per day and two quarts of oil.

The total cost per day of operation of gasoline locomotive train is $5.40 for 142 tons hauled three miles.

The cost of unloading is 10 cents per ton.

The following is the record for three days' hauling:

LOG OF HAULS.

December 12, 1915.

Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	14	4	10	sand
2	11	1	10	sand
3	14	13	1	rock
4	14	1	13	rock
Total	53	19	24	

Total yards, 73½; total tons, 110; total expense, $16.40; distance hauled, 3 miles.

December 13, 1915.

Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	12	6	6	rock
2	11	9	2	rock
3	12	6	6	rock
4	12	6	6	rock
5	10	9	1	sand
6	10	1	9	sand
Total	67	37	30	

Total yards, 96½; total tons, 142; total expense, $16.40; distance hauled, 3 miles.

December 14, 1915.

Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	12	5	7	sand
2	12	6	6	sand
3	12	5	7	sand
4	11	9	2	sand
5	12	7	5	rock
6	12	3	9	rock
7	11	5	6	rock
Total	82	40	42	

Total yards, 116; total tons, 174; total expense, $16.40; distance to be hauled, 3 miles.

Note.—The "total expense" includes locomotive engineer, fuel and oil, track foreman, material men, assistant material men. This labor includes the complete operation of the locomotive hauling, including the maintenance of the track and the dumping of the material on the sub-grade.

White & Gaskill feel that they eliminated a lot of grief by purchasing the railroad, and no doubt will pay for the same out of savings of two contracts. They are handling all the work except grading, which is sublet to local parties.

The camp which these contractors have established is

LAKEWOOD CARS *on California road job.*

spoken of by all who have seen it as being a model in all respects. It is located in a fine eucalyptus grove, which is right along the first section of road. The tents all have a raised wooden floor. They are equipped with iron cots and each man keeps his tent very clean.

The cook house is as clean as almost any home, being run by a man and his wife on salary. It is far ahead of the restaurants and hotels of that district.

Mr. Gaskill, who has personal charge of this contract, prides himself upon having a force of laborers all of whom are of known quality, having been with him for some time. He has provided a hot shower for the camp and has a splendid cooler for his provisions. This is loaded under his storage tank and has walls made of burlap. By having water drip upon this continuously and by the theory of evaporation, the provisions are practically in cold storage.

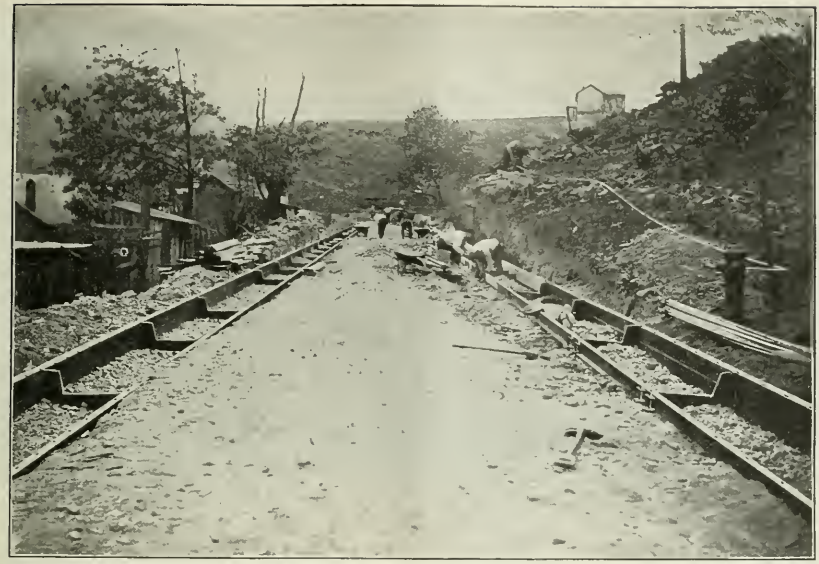
Four of the men have their families on the job, having their own tent houses. The contractors have also provided a large tent with a stove and benches which is used as a general loafing room by the men at night and days when they are not working.

Use of Six-Inch Side Rails

We are illustrating 6-inch side rails as used on back of curb and front of gutter by the Pietro Paving and Construction Co., Morgantown, W. Va., on 12 miles of street paving in 1915.

The same side rails which are used on sidewalk, curb, concrete road and combined base and curb construction are used on curb and gutter work.

The back face of the curb is formed by bolting any number



SHOWING TWO 6-INCH RAILS ON BACK OF CURB AND SINGLE 6-INCH RAIL FOR FRONT OF GUTTER. PIETRO PAVING AND CONSTRUCTION COMPANY, MORGANTOWN, W. VA., CONTRACTORS.

of side rails together, or by using a single rail of the required height. The front face of the curb can be formed by either a steel face rail or by a wood face rail. We recommend the use of steel face rails, as they are more quickly and easily handled than wood face rails and no clamps or bracing are required.

The front face of the gutter is formed by a Universal rail of the proper height. The expansion joints in the concrete are taken care of by dividing plates, which conform to the design required. These dividing plates are removed before the side rails and serve as templates by which to strike off and finish the curb and gutter. The side rails being slotted every 12 inches, expansion joints can be made wherever desired. The rails illustrated were furnished by the Blaw Steel Construction Co., Pittsburg, Pa.

Bitoslag Pavement

A new candidate for favor in the paving field is the bitoslag pavement, so named from the use of a specially prepared asphalt and crushed and pulverized slag in proper proportions in its manufacture. The first pavement was laid in McKeesport, Pa., in 1910, and the second in Germantown in 1915, and it is now considered to have demonstrated its success. The pavement is patented by J. C. Rock and is owned by the Bitoslag Paving Co., 90 West street, New York, who have issued a booklet describing the pavement and giving full specifications for all the materials and for the mixture and laying it on the road.

New Cement Plant at Duluth

The Duluth plant of the Universal Portland Cement Co. began operations February 15. Mill No. 7, as it is called, has four kilns, 150 feet long, with a daily capacity of 4,000 barrels. As in the case of other Universal mills, blast furnace slag and limestone are the raw materials. The plant adjoins that of the Minnesota Steel Co., which supplies the slag, and the limestone comes from Calcite, Mich.

All the grinding and burning machinery, elevators and conveyors are operated by individual motors and the same processes of manufacture are used as in the other mills of the company.

Power is furnished by the Great Northern Power Co. from its hydro-electric plant at Thompson, Minn., on the St. Louis river, 15 miles distant. Four thousand k.w. at 66,000 volts come to the power company's transformer at the plant, where the voltage is stepped down to 2,200. About half the current is used direct at this voltage, the other half being stepped down to 220 volts for the smaller motors.

The seventeen buildings are of reinforced concrete construction or of steel frame with curtain walls of concrete blocks. Floors and roofs are also of concrete. The storage tanks, twenty-seven in number, are of circular concrete design.

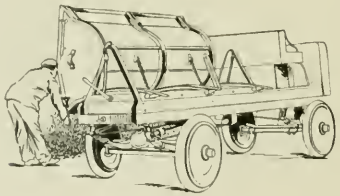
The plant employs between 300 and 400 men, for whose accommodation and also the employes of the Minnesota Steel Co., an industrial town, called Morgan Park, has been built near the plant. All the houses, streets, alleys, sidewalks, curbs and gutters in the town are of concrete. There are approximately 400 residences, including apartments and dwelling houses of such diversity of design that there is no suggestion of the monotonous uniformity usually prevailing in industrial towns.

A Keep-to-the-Right Standard

The Cutter traffic post has been designed to meet the demand for an attractive and efficient traffic signal. It is now in use in Chicago, St. Louis, South Bend and many other cities. The post is cast of the best quality gray iron from metal patterns, thus insuring clean castings, true to the ornamental design. The globe is made of light-density translucent glassware, ruby in color, combining high transmission qualities with good diffusion. With the high-candle-power lamp, the lighting unit can be seen at a distance under the worst of weather conditions and yet does not produce glare, thus meet-

CUTTER TRAFFIC POST MARKING CENTER OF INTERSECTING STREETS.

ing the most important requirements of an efficient signal. The base is 14 inches in diameter and 24 inches high. The column is 5 inches in diameter above the base, tapering to 3½ inches in diameter near the top. The height from the base plane to the bottom of the globe is 6 feet. The post has a 6-inch globe holder and is designed for 6 by 14-inch diffusing globes, but any globe with a 6-inch fitter can be used. These posts are made by the Geo. Cutter Co., South Bend, Ind.



Motor Trucks of America

The above sketch illustrates a Lee side-dumping truck body mounted on a Jeffery "Quad" chassis. This body dumps the load sideways. When the body is divided lengthwise into two compartments, half the load can be dumped to the left and half to the right of the truck.

This is only one of twenty-six devices equally as important, described and illustrated in an article entitled "Devices that Make for Motor Truck Efficiency," printed as an introduction to the 1916 edition (Volume IV) of "Motor Trucks of America."

This valuable hand-book, just off the press, is bigger and better than ever. All the principal motor trucks made in the United States are represented by photographs and tables of specifications covering all models. The specifications are arranged after a uniform plan, so that one truck can be readily compared with another.

This book is not for sale, but is published annually by The B. F. Goodrich Company for free distribution, not only to truck manufacturers, agents and salesmen, but to truck owners as well, and business firms contemplating the purchase of trucks. Requests should be written on business letterheads, and addressed to The B. F. Goodrich Company, Akron, O.

Road Surfacing

Road surfacing, as distinguished from applications of oil for dust laying, is covered in principle and practice in a booklet, "Trinidad Liquid Asphalt," just issued by the Barber Asphalt Paving Company, Philadelphia. The essentials of successful "carpet coating" with asphaltic materials are fully explained. As illustrations, the pamphlet contains photos of park drives, city boulevards, suburban streets and country roads resurfaced with liquid asphalt by both hot and cold applications. Full specifications, in the form of explicit directions for the laying of carpet coats, are included.

Blawform Bulletin 69

The Blaw Steel Construction Company, of Pittsburg, Pa., are mailing Bulletin 69, which contains twenty-eight pages of illustrations and descriptions of sidewalk, curb, curb and gutter and road forms; each form described is illustrated.

This bulletin also contains many large half-tone illustrations of forms as being placed by prominent contractor concerns thruout the country. Particular attention is called to the illustrations and descriptions of forms for combined base and curb construction, concrete curb construction, combined curb and gutter construction, sidewalk construction, etc.

Koehring Builds Low Price Mixer

The Koehring Machine Company, Milwaukee, Wis., displayed two new mixers at the Chicago Show, which will be built in big volume on the "Ford" plan—fast manufacture of strictly standardized machines in big volume to make low price possible.

These mixers are called the "Dandie" line, consisting of construction-type mixers in 5 cubic feet and 10 cubic feet capacities, and a high-drum, end-loading paver, built in 10 cubic feet and 20 cubic feet capacities.

The Dandie construction-type mixer is a low-down mixer with platform for wheel-barrow charging, and may also be equipped with batch hopper and power loading-skip. The mixing action is the same as on regular Koehring mixers, with discharge spout extending inside the drum, and in mixing position forming part of the mixing section. This chute is reversed to discharge. The trucks are extra strong, and tires

How did *your* roads come through the winter?

ARE your macadam roads frost-proof? Are they in good condition this Spring? Or are you now going through a season of dirt and mud "while the frost is coming out". In a typical American township today are these examples of "spring" roads:

Note the clean, smooth, dustless Tarvia surface.

Case 1. Old plain macadam

Worn down by automobiles, exposing the uneven basic mosaic which has caught water and suffered severely from disruption by frost. Considerable loose stone. Mud now—dust later. No relief till warm weather when expensive resurfacing will be in order. Deterioration is 40%.

Case 2. New macadam last year

Still a good road but with a one-inch film of mud in wet weather and dust in dry. The smooth "roof" of the road is being destroyed. Already the road fails to shed water promptly, although the foundation is still intact. Deterioration 15%.

Case 3. Old macadam street treated with oil to suppress dust

Effect of the oiling has worn off. Plenty of dust now, or slimy black mud. Deterioration going on steadily because the oil had no bonding or dust-preventing power—it merely made the dust too heavy to blow. No relief in sight. After mud dries dust must blow till weather is warm enough for re-oiling. Can't even sprinkle with water on account of the old oil.

The foregoing represents the result of old and wasteful methods of road construction. We will now tell you of results where newer and more economical methods were used.

Case 4. Old macadam treated last year with a coat of "Tarvia-B"

Applied from a sprinkling cart, the Tarvia soaked into the surface forming a sort of tough tar-concrete. Sheds water like a duck. No mud or dust. No deterioration. Looks as good as it was last Fall. Needs only light renewals of "Tarvia-B" to make it better than ever.

Case 5. New macadam built with heavy "Tarvia-X"

Constructed layer by layer three years ago. The Tarvia cements the stone together in a traffic resisting layer. It added slightly to the original cost but saved much stone and labor. Clean, dry and smooth. It it shows any wear a light coat of "Tarvia-B" restores it to prime condition.

Tarvia makes macadam frost-proof, winter-proof and automobile-proof. It is a tough, dense, viscid binder, a plastic cement that defies water, weather and traffic.

Expense? Tarvia adds a little at the beginning and saves a lot in the end on the obvious principle that it is cheaper to have a road that will easily withstand modern traffic than to keep on renewing an inferior type of surface that is too weak for the traffic.

A road that pulverizes and abrades under the attrition of the backward kick of the automobile driving-wheels is an expensive nuisance nowadays. That is why the plain macadam road is disappearing.

Durable, dustless tarvia-bonded roads really cost less than dusty, water-bonded macadam roads owing to their longer life and lower maintenance costs.

There is a Tarvia process for most road problems.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by anyone interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Illustrated booklet on request.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria
The Paterson Manufacturing Company, Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

extra wide. All bearings are constructed on the universal principle. Double-drum drive-gears are cast from special composition metal. The power loading-skip has automatic knock-out and brake, automatically stopping skip in charging position and holding it until released.

The Koehring three-way-valve automatic water measuring tank may be had on these mixers.

The "Dandie" high-drum pavers are built in 10 cubic feet and 20 cubic feet capacities. This height of drum affords an unusually great spouting range, and makes possible the steep angle that causes fast flow of creamy concrete. The loading-skip accommodates two wheelers at the same time, and is provided with automatic knock-out and locks. The spout is self-compensating, maintaining the point of discharge at the same distance from the ground, regardless of how many sections are in use. The Dandie pavers are powered with gasoline engine, or with steam boiler and engine. Power plants on all Dandie mixers are securely housed. The Koehring Machine Company is distributing special literature on the Dandie line. Booklet E-33 on the low-charging mixer, and Booklet F-33 on the Dandie paver.

Kahn Portable Buildings

Kahn portable buildings have a wide range of usage and are to be had in units suitable for contractor and school purposes, as well as for hospitals, election booths, tool and material storage houses, etc.

Contractors, railroads and construction companies will find these units ideal buildings for offices, storage, bunk houses, etc. They are quickly erected and taken down and easily moved to the next job.

Being built of sectional units, they can be made in any sizes. The panels are interchangeable, so that the contractor can make his building either large or small, with practically any desired arrangement as regards doors, windows, etc.

The method of construction consists essentially of various pressed steel panels and units which can be assembled by anyone without special tools or equipment. By an ingenious but simple device, consisting of a slotted key and locking wedge, the entire building can be fastened together in an incredibly short time. No holes need be punched, no rivets driven, no bolts nor wire are used. An ordinary hammer is the only tool required. The various panels are of standard size and interchangeable, permitting buildings of any size or arrangement of wall space, windows and doors. The whole idea is as simple as building up a library with sectional bookcases.

The solid wall panels are manufactured from the highest grade of heavy-gage open-hearth steel and formed under large dies operated by powerful presses. All the operations of cutting, beading, punching, etc., are performed on specially designed machinery. The corners of the panels are electrically welded to assure maximum strength and weather-tightness. The simple paneling of the walls, while adding greatly to the strength, also presents a most pleasing appearance.

As for light and ventilation, these are provided for by the use of glazed panels which consist of steel sash welded into the standard wall panel. The sash is complete with pivoting and adjusting devices as well as all hardware. The center pivoted ventilator permits 100 per cent. ventilation, while the standard push bar and locking device allow wide variation in the adjustment of the ventilators.

These Kahn buildings are made by the Trussed Concrete Steel Co., Youngstown, O.

Brownhoist Drag-Line Excavator

The Brownhoist drag-line excavator can be used for digging canals and ditches, constructing levees, and for digging in certain kinds of ore. Due to the fact that such a large quantity of material is handled at a bucket load, this machine handles a large yardage in a day's time, at a low cost per yard. The booms vary in length up to 120 feet and the drag-line buckets vary in capacity up to 4 yards. Two men are required on the machine, one for operating and one for firing, while two to four men are needed on the ground, the number depending on the working conditions.

In digging canals and ditches the excavator works along the bank, digging the canal or ditch any width up to 100 feet and placing the spoil back from the bank any distance up to 120 feet. The machine can be equipped with skids or trucks, but the skids and rollers are generally used, as shown in one of the cuts. The machine is blocked while operating, and when it is necessary to advance, the blocks can be removed and, by placing the bucket in the ground, the machine will pull itself along the runway of heavy timbers.

KAHN PORTABLE BUILDING FOR VARIED PURPOSES.

Cave Life or Civilization

Civilized man is distinguished from the cave man by his habit of co-operation.

The cave man lived for and by himself; independent of others, but always in danger from natural laws.

To the extent that we assist one another, dividing up the tasks, we increase our capacity for production, and attain the advantages of civilization.

We may sometimes disregard our dependence on others. But suppose the farmer, for example, undertook to live strictly by his own efforts. He might eke out an existence, but it would not be a civilized existence nor would it satisfy him.

He needs better food and clothes and shelter and implements than he could provide unassisted. He requires a market for his surplus products, and the means of transportation and exchange.

He should not forget who makes his clothes, his shoes, his tools, his vehicles and his tableware, or who mines his metals, or who provides his pepper and salt, his books and papers, or who furnishes the ready means of transportation and exchange whereby his myriad wants are supplied.

Neither should he forget that the more he assists others the more they can assist him.

Take the telephone specialists of the Bell System: the more efficient they are, the more effectively the farmer and every other human factor of civilization can provide for their own needs and comforts.

Or take our government, entrusted with the task of regulating, controlling and protecting a hundred million people. It is to the advantage of everyone that the government shall be so efficient in its special task that all of us may perform our duties under the most favorable conditions. Interdependence means civilized existence.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

DUMPING THE BUCKET WITH THE SPECIAL TRIP LINE.

"This type of excavator," states Mr. Melvin Pattison, general sales manager of the Brown Hoisting Machinery Co., "is built for speed as well as durability. It is equipped with a high-speed powerful engine, which is direct-connected thru Brown patented friction clutches, to the hoist and drag-line drums, and also to the rotating mechanism. The machine can be rotated in either direction simultaneously with the hoisting or lowering of the bucket.

"The circular track on which the wheels run is securely fastened to the rotating gear. This keeps the track and gear always in line, which results in easy operation at all times and in least wear on the rotating parts. The rotating gear is made to a large diameter, which gives a good mesh between the rotating pinion and gear.

"A large capacity boiler with feed water heater is used, so as to give ample power when the excavator is working at full capacity, and ample space is provided for coal.

"All clutches are operated by air furnished by a steam-operated air pump, which makes the operation very easy. The operator stands at the foot of the boom, where he has a good view of the work, and all levers and air valves for the clutches are within easy reach. The hoist-line runs from the drum to the head of the boom and to the bucket. The drag-line runs from its drum directly to the bucket, passing thru the two guiding sheaves located at the foot of the boom."

Fewer Truck Wheel Diameters Step Toward Lower Tire Prices

"Truck operators everywhere, we feel, can exert a marked influence toward the ultimate end of reduced solid tire prices," declares S. V. Norton, manager of truck tire sales for the B. F. Goodrich Company, Akron, Ohio, "by supporting the movement for a reduction in the number of standard S. A. E. wheel diameter sizes.

"Experience of all tire manufacturers, wheel builders and makers of steel rims," continues Mr. Norton, "has proved that unnecessary manufacturing costs can be eliminated thru universal adoption by truck makers of fewer wheel sizes than the number used at present. Instead of honoring specifications for six different wheel diameters, 32, 34, 36, 40 and 42, and these to be had in seven different widths, making forty-two different sizes, half this number is amply sufficient to answer the service demands of any form or make of commercial motor vehicles. With only three standard diameters, 34, 36 and 40 inches, to be provided, manufacturing and selling costs will be reduced, and the net result will prove greatly to the advantage of the ultimate consumer."

The Society of Automobile Engineers has already revised its original standards of 1911 to provide for only the three most practical and most-in-use diameters, viz., 34, 36 and 40 inches. A vigorous campaign is now on to influence all truck manufacturers to put into practice this recommendation for fewer diameters. At present 75 to 80 per cent. of all tires sold are 36 and 40-inch sizes. Probably 90 per cent. of the tires applied to newly-manufactured trucks are of these two diameters, while the 34-inch size is included to take care of trucks whoes design requires a smaller wheel.

"By simplified manufacturing processes," says Mr. Norton, "tire costs are bound to decrease in proportion as fewer molds and less special tire building machinery is required. Moreover it is far more economical in point of capital invested, for the manufacturer to stock only twelve or fourteen sizes, and decidedly more convenient, than to continue as at present keeping on hand from thirty to forty different sizes, in all distributing centers.

The Motor Truck and the Farmer

Before he bought his motor truck Edward Franzmeier got up at midnight and left at 1 a. m. arriving at the St. Paul market at 4 or 4:30 a. m. Now he rises at 4 a. m., starts at 4:15, arriving at the market at 5. He says that when the market is good he is often home again at 7 a. m. ready for a day's work. By the old method he was away from home from midnight until noon and came back with a tired team and himself in no condition to do very much work that day.

Mr. Franzmeier says he would not be without a truck and the Kissel Kar he bought suits him exactly. All of his farm hauling is done with it—such as hauling machinery or taking plows to the blacksmith, so that his horses are reserved for work in the fields.

Roughen Adjustable Paving Gage

We are illustrating the Roughen adjustable paving gage, which is adjustable to crown and width of pavement. This device is used either on top of a plain curb or on the gutter of a combined curb and gutter, and is easily moved along the street. The templates, two to each gage, made from selected timbers, are steel shod and fastened to the mast in the center of the gage and attached at the outer end to the steel extension plates. From 2 inches to 4 feet can easily be added to the length of any gage by drawing out the extension plates. On each side of the templates are trestle rods that hold the gage rigid, and extended from the top of the mast are the adjustable

Atlantic H. O. Asphalt applied to Lansdowne, Pa., Streets

Atlantic H. O. Asphalt

(Applied Hot)

Reduces Road-Maintenance Cost

This is the tried-and-true paving material that seals and waterproofs roads perfectly, producing a hard, tough surface that resists the incessant, abrasive onslaughts of traffic. Atlantic H. O. Asphalt is not a theoretical road-material—it is now and *has* been giving perfect service on mile after mile of urban and rural roads, under hardest conditions.

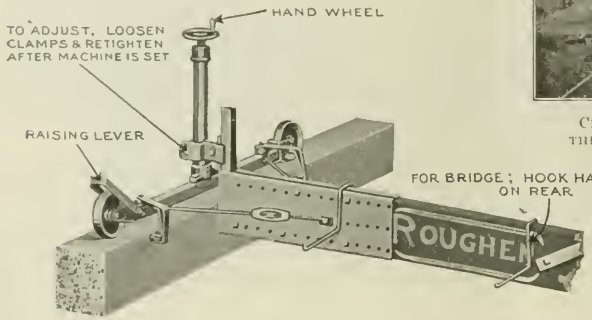
Atlantic H. O. Asphalt is Mexican asphalt, pure, tough and rubbery. It is heavy, waterproof and durable to a surprising degree. It gives best results when covered with finely crushed stone-chips or gravel. Applied by the Atlantic Refining Company's modern equipment operated by experienced men, under the exacting supervision of roadway experts. We will gladly furnish specific information as to quantities required, methods of application, etc.

The Atlantic Refining Company
Philadelphia Pittsburgh

rods provided with lock nuts to set and hold templates to the desired crown.

When the adjustment desired exceeds 4 feet, it is only necessary to procure new templates of such dimensions as will make the machine the desired width. These can be purchased from the manufacturer at low cost.

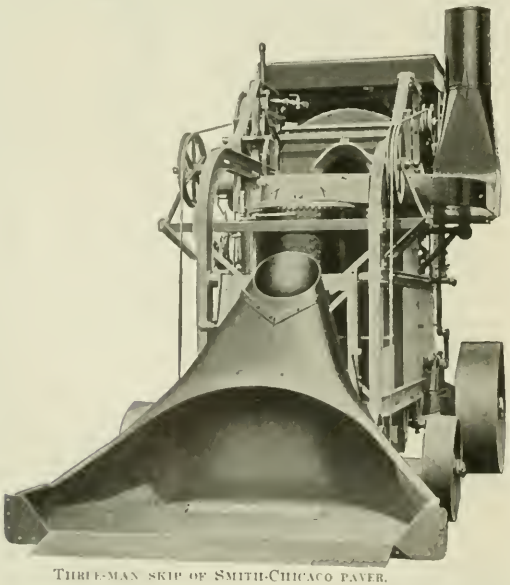
The sand should be spread by the gage to conform to the true curvature of the concrete base. The rounded, steel-faced


HAND WHEEL
TO ADJUST, LOOSEN CLAMPS & RETIGHTEN AFTER MACHINE IS SET
RAISING LEVER
FOR BRIDGE; HOOK HANGERS ON REAR
ROUGHEN

BACK VIEW SHOWING MACHINE SET FOR STRAIGHT CURB

edge of the template shoes, with the weight of the gage, if not alone sufficient, will at least greatly assist the compression of the cushion, which, together with the use of the hand roller, secures a sand cushion meeting the recommendations of the National Paving Brick Manufacturers' Association.

The gage is made into a bridge by tilting the levers up, so that the templates are raised about 1 inch above the work. A sufficient number of steel hangers are supplied with the machine so that a plank walk may be attached on the side of the gage. For finishing cement pavements, the bridge walk is ideal for finishers to work from, as the finishing progresses much faster and better and no board marks are left on the finished street. The machine may be used as a strike-off without removing bridge.



THREE-MAN SKIP OF SMITH-CHICAGO PAVER.

CEMENT PAVING AT LAKE MILLS, WIS., MADE PERFECT THRU USE OF ROUGHEN GAGE. ALSO USED AS A BRIDGE.

Trade Notes

The Badger Meter Mfg. Co., of Milwaukee, Wis., has been awarded the contract for furnishing the city of St. Paul, Minn., with water meters, from ⅝ inch to 1¼ inches, inclusive, for their 1916 requirements.

Mr. Dougherty, of the D. & D. Safety Cover Co., is making a trip from St. Paul to Boston, calling on city engineers on the way in the interest of his D. & D. safety cover for manholes and catchbasins.

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The offices of the Mexican Petroleum Corporation, Huasteca Petroleum Co., Petroleum Transport Co. and The Caloric Co., have been removed to 280 Equitable Building, 120 Broadway, New York.

Standard specifications for steel rails of the American Railway Association, the American Society for Testing Materials, and manufacturers of rails are collected in a booklet of Robert W. Hunt & Co., engineers, Chicago, Ill.

New Smith-Chicago Paver

One of the new features of the late model Smith-Chicago paver is a water-weighing device which measures each batch of water by weights.

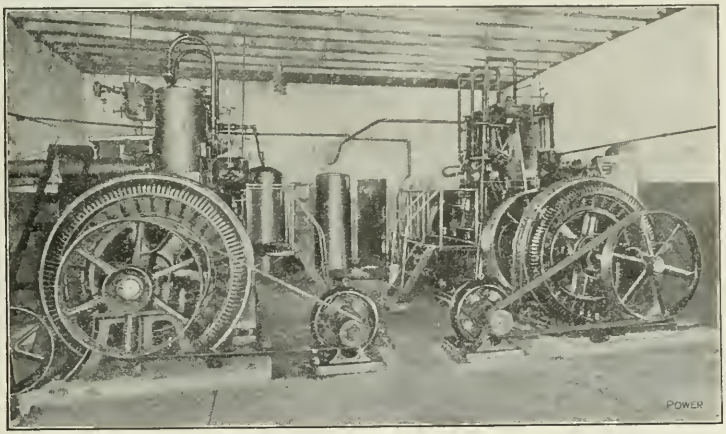
Another very important feature in this new machine is the long, steep chute. This chute is pitched at a 20-degree angle, so that even the stiffest concrete used for road work will easily slide down it. It is equipped with four intermediate discharge openings and an auxiliary swivel chute so that the concrete will not have to drop to the ground. With these four openings and the auxiliary chute a wide area can be concreted without moving the machine.

Another important feature is the fact that all the operating and driving gears are of steel and these are all carried on a large steel casting supported by the rear wheels. In this way there can be absolutely no chance for them to get out of alinement.

All sizes of this machine are equipped with powerful forward and reverse traction mechanism. The weight is all centrally located, so that there is no chance for the machine to be over-balanced.

The loading skip is made wide enough so that two or three barrows can be emptied into it simultaneously.

M & W Oil Engines



are paying off the debts

of Opelousas, Louisiana. For fifteen years the municipal water and lighting plant of this city of 5000 population was operated by steam power and just about paid expenses.

About six years ago the price of coal went up and the plant was operated at a loss until money enough for the engineers' wages was hard to get.

Finally, in desperation, the city government increased the tax rate, anticipated this revenue for two years and borrowed money for the purchase of a 100 hp. M & W OIL ENGINE, direct-connected to a 100 kva. alternator. They arranged to pay the balance due on account of the purchase of this engine and its auxiliaries out of the income from electric and water service, at the rate of $200 per month with interest.

This unit was so successful that another one of 150 hp. was soon installed. The city is now paying $450 per month towards the cost of the power plant, besides all labor and operating expenses —it is almost out of debt, and will soon have a surplus to apply towards the reduction of the tax rate. As compared with the steam power plant the two M & W engines

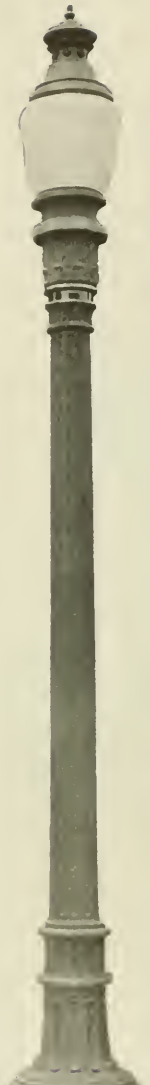
Save More Than Their First Cost Every Year

If your town is struggling under the handicap of the steam-driven pumping or lighting plant, get in touch with us and let our engineers look into your problem and tell you what savings M & W oil engines can effect for you.

AUGUST MIETZ MACHINE WORKS

131 MOTT STREET, NEW YORK.

71-11



Street Lighting in Detroit

The accompanying photograph shows one of the ornamental posts and lights used in Detroit in the municipal lighting system described on page 128 of this number of MUNICIPAL ENGINEERING. These ornamental posts are of the Broadway design manufactured by the George Cutter Company, of South Bend, Ind. They add materially to the artistic effect of the lights, and their daylight appearance is also very satisfactory. Heavy posts with large arms are so overpowering by day that the citizen is liable to forget the good effect of the lights at night because of the insistent size of the lamp supports by day, when they are constantly before him when he is on the street. No such complaint can be made of these posts.

Trade Publications

A "Bibliography of Municipal Government," by William Bennett Munro, Ph. D., LL. B., professor of municipal government in Harvard University, contains a classified list of the best materials available for study in every branch of municipal affairs. Particular attention is given to official reports, and to authoritative articles in scientific periodicals on such matters as water supply, sanitation, public lighting, street railways, and so forth. By far the largest part of the references are to publications which have appeared within the last twelve or fifteen years. Great care has been taken to arrange the materials s othat they may be easily found, and many of the citations have critical notes. An elaborate author-and-subject index is appended. It is published by the Harvard University Press ,Cambridge, Mass.. at $2.50. 472 pp.

"Municipal Charters" is a book by Nathan Matthews, LL. D., mayor of Boston from 1891-95, chairman Boston finance commission, 1907-09; lecturer on municipal government in Harvard University, of 219 pp. Published at $2 by Harvard University Press, Cambridge, Mass.

The annual report of the business and transactions of the president of the Boro of Manhattan, New York City, for 1914 has just been received. It gives the structure of the boro government, digests of the reports of heads of sub-divisions and full detailed reports from the Department of Public Works and the Bureau of Buildings. Marcus M. Marks, Boro President.

Bulletin 31U of the Chicago Pneumatic Tool Company gives instructions for installing and operating Chicago pneumatic Class N-80 fuel oil driven compressors.

The Roughen adjustable paving gage is described in a circular issued by P. Roughen, Fond du Lac, Wis.

Booklets A370 and A371 are two sections of a treatise on high explosives, issued by the E. I duPont de Nemours Co., Wilmington, Del., the first section treating of their manufacture, handling, storage and use, and the second section giving in detail the kinds, grades and brands, with full statements of the important properties of each kind and the class of work to which each is particularly adapted.

Clifford Richardson, consulting asphalt engineer, New York, has written two papers on "The Theory of the Perfect Sheet Asphalt Pavement" and on "Trinidad and Bermudez Lake Asphalts and Their Use in Highway Construction," which have been reprinted by The Barber Asphalt Paving Company, Philadelphia, Pa., and copies can be obtained from them on request. "Good Pavements and How to Get Them" is the title of another handsome booklet issued by the company.

The advantages of Medusa waterproofed white portland cement are well stated in a booklet issued by the Sandusky Portland Cement Co., Cleveland, O., which is illustrated with views of many artistic and expensive structures in which the material has been used as a protection against deterioration on account of water, as well as for the artistic effect of the white cement.

Bulletin S 12 of the Ball Engine Company, Erie, Pa., illustrates the Erie revolving shovels.

Catalogs are issued by Crerar, Adams & Co., Chicago, Ill., of contractors' supplies on sale by them.

Scherzer rolling lift bridges, their inception, development and use, are well set forth in a fully illustrated booklet issued by the Scherzer Rolling Litt Bridge Co.. Chicago, Ill.

The Service Manual of the Service Motor Truck Co., Wabash, Ind., leaves little untold about the important details of this serviceable machine and the methods of operating them and keeping them in good condition.

A circular of the General Electric Co., on fundamentals of street lighting describes the use of holophane refractors on street lamps.

A pivoted bucket carrier for elevating and conveying coal, ashes, coke, stone, gravel, sand, etc., is described in Bulletin 17 of the Gifford-Wood Co., Hudson, N. Y.

A very convenient set of diagrams for computing the cost of pumping water under any practical conditions, covering the details of all steps in the process, is issued by the DeLaval Steam Turbine Co., Trenton, N. J., and will be sent by them on request.

Bulletin 84 on the Venturi meter will be sent on request by the Builders' Iron Foundry, Providence, R. I.

Hill's Cart and Wagon Works, Jersey City, N. J., make Hill's improved steel body spring pedestal balanced dumping truck, with canvas covers, to be used for making sanitary collection of refuse and garbage. The common sizes hold 3 and 4 cu. yds., but they are built both larger and smaller.

Bulletin S-14 of the Ball Engine Company, Erie, Pa., is a handsomely illustrated collection of facts, figures and photos of their Erie type B steam shovel.

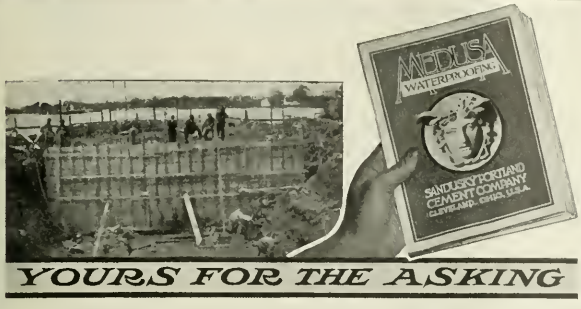
The Gramm-Bernstein Company, Lima, O., demonstrate the capabilities of their trucks in a booklet entitled "The World's Best in Motor Trucks."

"Conservation by Preservation" is the subject of a booklet on wood preservation issued by the C-A-Wood-Preserver Company, St. Louis, Mo.

The United States Asphalt Refining Company, of New York and Baltimore, issue a paper by Leroy M. Law, their chief chemist, which, under the title, "The Merits of Refined Asphalt Roads," gives details of the various kinds of asphalt derived from asphaltic oils, with special attention given to Mexican asphalts, showing the reasons for excellence and adaptability of these products.

The Hurst Silo Equipment Company, 819 Exchange street, Chicago, Ill., publish a catalog of Hurst gravity mass block, molds, rod and plate cutters and benders, door frame patterns, steps, etc.

The Whalen Form, Syracuse, N. Y., publish an illustrated circular giving details of their forms and photographs of installations and of culverts built with them.



YOURS FOR THE ASKING

Providence, R. I.,
December 11, 1915.

Sandusky Portland Cement Co.
Cleveland, Ohio.

Gentlemen:

I have used Medusa Waterproofing in all the reinforced concrete for the Disposal Plant and Pumping Stations at Warren, Rhode Island, with very satisfactory results.

The tanks and pumping stations are located near the water's edge and some twelve feet below high tide. The ground is marshy and wet, but the walls have proved to be dry and impervious to moisture as the result of using your Waterproofing.

Yours very truly,
CHARLES F. CHASE,
Consulting Engineer.

"Medusa Waterproofing" is a liberally illustrated Handy Book—You should have on File!

Engineers who are familiar with conditions in Warren, R. I., will readily realize that if Medusa Waterproofing proved successful at this point, it is truly a wonderful waterproofing material. Our booklet will further prove it—conclusively.

Medusa Waterproofing is manufactured in powder and paste form, and makes all concrete work *permanently* watertight. It does not affect strength or setting of cement.

"The Medusa Review," our house-organ, will be mailed to you regularly, free—send us your address!

SANDUSKY PORTLAND CEMENT CO.

Room X-1, Engineers Building. CLEVELAND, OHIO.

STREET LIGHT SYSTEMS
STATION, OVERHEAD and UNDERGROUND WORK
FROM PLANS TO LIGHTS ON
CONTRACTED FOR IN WHOLE OR IN PART
LET US REFER YOU TO SOME OF OUR CUSTOMERS

W. F. CUMMINGS
330 SO. PAULINA ST.
CHICAGO, ILLS.

Engineers Contractors

Fire Department Supplies

THE OLDEST AND LARGEST MANUFACTURER OF
EVERYTHING USED IN A FIRE DEPARTMENT

S. F. HAYWARD & CO.

39 PARK PLACE. NEW YORK CITY.

Contracting News

AUTOMOBILES. FIRE APPARATUS AND MOTOR EQUIPMENT.

BIDS REQUESTED.

Ashland, Ky.—April 17, until 7 p. m., for one triple combination pumping engine of not less than 100-h.p., pumping capacity of 750 gals. One 10-gal. chemical tank, 200 ft. chemical hose with hose body capacity of 1,200 ft., 2½ in. hose, with ladders and complete equipment, electric lights, electric self-starter, equipped with Dayton airless tires, maximum weight about 10,000 pounds. One 75-h.p. power motor city service truck, equipped with 35-ft. extension trussed ladder, equipped with Dayton airless tires, electric starter, etc. One 40-gal. chemical tank complete, maximum weight 8,000 pounds. Certified check $1,000. Address City Clerk.

Bay City, Tex.—Purchase of motor-driven fire apparatus is urged by members of fire department. Mr. Sutherland, mayor.

Bellingham, Wash.—Motor apparatus is being investigated with view to purchase. J. J. Marsh, fire chief.

Bloomington, Ill.—Ordinance adopted providing for purchase of fire truck and other apparatus. Bond issue $5,000. E. E. Jones, mayor.

Brockton, Mass.—Ordinance passed providing appropriation of $10,000 for motor-driven apparatus. John S. Burbank, mayor.

Colorado Springs, Col.—Purchase of new car for assistant fire chief authorized. Auto now in use to be sold. M. Donohue, assistant fire chief.

Elgin, Ill.—City will purchase a third combination chemical and hose truck this year. Wm. Haible, fire marshal.

Galveston, Tex.—Appropriation of $12,000 will probably be made for purchase of two pieces of apparatus. Lewis Fisher, mayor.

Highland Park, N. J. (P. O. New Brunswick).—April 10, until 8 p. m., for bronze rotary gear fire pump, capacity 500 gals. per minute, with suitable relief valves and 2½-in. hose gates, two lengths 6-in. flexible suction hose coupled, one metal suction strainer and necessary hydrant connections. Frank A. Metzrath, boro clerk.

Laporte, Ind.—Purchase of additional motor-driven fire truck, possibly one with motor-driven pump attached, being considered. David H. McGill, mayor.

Lindsey, Ohio—Plans being considered for installation of fire protection facilities.

Logan, Ohio—Bonds will be issued for purchase of motor fire apparatus.

Madison, Ind.—Purchase of triple combination fire apparatus by Washington Fire Co. No. 2 contemplated. James E. Crozier, mayor.

Marinette, Wis.—Purchase of motor combination chemical and hose car and chief's car recommended by Fire Chief Joshua Hodgins.

Montgomery, Ala.—City will purchase one aerial truck and combination chemical, hose and pump truck, both motor-driven. W. A. Gunter, Jr., mayor.

Nashville, Tenn.—Purchase of one small automobile for commissioner of water works being considered. Mr. Elliott, commr.

Northampton, Mass.—Motorization of fire apparatus being considered. William H. Feiker, mayor.

Portsmouth, Ohio—Bond issue of $30,000 provided for completely motorizing fire department. Adam Frick, mayor.

Portsmouth, Va.—Recommendation for purchase of auto combination engine and chemical wagon adopted by city council. F. S. Hope, mayor.

Seattle, Wash.—Ordinance authorizing purchase of four runabouts to cost $1,800 referred to city purchasing agent. W. D. Freemans.

Temple, Okla.—Reorganization of fire department and purchase of new equipment reported.

Warwick, N. Y.—Purchase of motor-driven chemical and pumping fire truck being considered. Appropriation of $5,000 proposed. Address Excelsior Hose Co.

Watts, Cal.—Bond issue of $12,000 for purchase of fire equipment will be voted on April 16.

Youngstown, Ohio—Bond issue of $5,500 authorized for purchase and installation of fire hose and fire hydrant couplings. M. F. Hyland, city clerk.

BRIDGES.

BIDS REQUESTED.

Bartow, Fla.—April 18, until 10 a. m., for about twenty concrete-steel bridges and ninety reinforced concrete culverts in Polk county. Certified check $2,000. Address Bd. of County Commrs.

Concordia, Kans.—April 16, until noon, for twelve reinforced concrete bridges in county. Geo. C. Guilbert, county clerk.

Danville, Ind.—April 15, until 10:30 a. m., for two steel and nine concrete bridges in Hendricks county. C. M. Havens, county auditor.

Nashville, Tenn.—April 18, until 10 a. m., for Charlotte avenue overhead bridge and approaches. Robert Ewing, mayor.

Odessa, Wash.—May 1, until 8 p. m., for three different types of bridges, one all steel bridge with wood floor, one two-span steel bridge with concrete floor, one two-span concrete arch bridge. W. M. Nevins, city clerk.

Rock Island, Ill.—April 15, until 2 p. m., for reinforced concrete bridge, known as Colona bridge, across Rock river, between Colona township, Henry county, and Hampton township, Rock Island county. Estimated cost, $60,000. All alternative plans to receive consideration, must be on file at county clerk's office in Rock Island not later than April 8. Clifford Older, bridge engineer, state highway engineer, Springfield, Ill.

Rising Sun, Ind.—April 20, until noon, for bridge construction. Bridge to be erected jointly by Dearborn and Ohio counties. J. R. Elder, Co. Aud., Ohio county.

Sacramento, Cal.—April 17, until 2 p. m., for bridge across Eel river, south of Scotia in Humboldt Co. Bridge comprises two steel truss spans, each 302 ft. long with two reinforced concrete approaches; total length, about 893 ft. State Highway Comm. will furnish material—portland cement. Address Cal. Highway Comm., 515 Forum Bldgs., Sacramento.

Youngstown, O.—April 17, until 1 p. m., for reinforced concrete bridge over West driveway in Lincoln Park, length 70 ft. Certified check $200. Frank H. Vogan, Clk. Mahoning Co. Commrs.

Youngstown, O.—April 17, until 1 p. m., for reinforced concrete bridge, length 70 ft., on McCartney road. Certified check $200. Frank H. Vogan, Clk. Mahoning Co. Commrs.

CONTRACTS AWARDED.

Albany, N. Y.—To Spaulding Constr. Co., Suffield, Conn., highway bridge over Hudson river, at $31,284.

East St. Louis, Ill.—To East St. Louis Bridge Co., East St. Louis, Ill., bridge across Tippecanoe river, superstructure for same and removing old spans, at $16,988. Also received contract for two concrete piers and abutments, at $1.48 per cu. yd.

Hamilton, O.—A. J. Yawger Co., probable contractors for Columbia bridge. Lowest bidders on county plans. Bid $117,464.

Princeton, Ill.—Boes & Higman, Wyanet, Ill., eleven reinforced concrete bridges for county, at $15,215.

CONTEMPLATED WORK.

Camden, N. J.—Plans drawn for $20,000,000 bridge to span Delaware river, between this city and Philadelphia. Structure as planned calls for high-level, double deck cantilever steel affair, over which trolley tracks, truck decks and footways are to extend. Board made up of Philadelphia officials will co-operate with commission already named by Camden, Burlington and Gloucester Cos. and one recently appointed by Governor Fielder.

Franklin Boro, Pa.—Plans completed for concrete overhead bridge to replace structure at upper end of Woodvale, connecting Franklin and Woodvale. Plans call for reinforced concrete bridge, about 900 ft. long. Estimated cost of bridge as planned, $90,000. A. B. Curry, Boro Engr.

Freeport, Tex.—Concrete and steel bridge will be constructed across Brazos River, connecting Velasco and Freeport, at cost of about $100,000, by Brazoria Co. and railroad company.

Hamilton, O.—Plans being prepared for concrete bridge at Stevens farm in Reily Twp., length 111 ft. Estimated cost, $6,000. Fred Hammerle, Co. Engr.

Hartington, Neb.—April 7, until 2 p. m., for bridge construction for 1916 in county. H. C. Beaty, Co. Clk.

Kearney, Neb.—Plans for proposed new Platte river bridge will be completed about April 12. Address Co. Bd. of Supervs.

Knoxville, Tenn.—Preliminary plans being drawn for viaduct from State St. to Williams St., across Southern Railway yards. Reinforced concrete is material specified. John W. Flenniken, Commr.

Leavenworth, Kans.—Bids will be asked soon for repairing Fourth St. viaduct. Estimated cost, $13,311. Harry Perkins, Cy. Engr.

Lorain, O.—Plans completed and now waiting approval of State Highway Commrs. for concrete and steel bridge over Beaver creek on Lake Shore highway. Estimated cost, between $6,000 and $7,000. Address Co. Commrs.

Mount Holly, N. J.—Construction of fixed bridge across Rancocas river, at King St., Mt. Holly, will be given public hearing April 6.

Murray, Utah—Construction of cement bridge over Jordan river on 17th South St. decided on by Co. Commrs.

Oakland, Cal.—Preliminary steps taken for abolishing old swing bridge over Oakland's inner harbor from Oakland to Alameda, by city officials of Oakland, Berkeley and Alameda. Erection of bascule type bridges being considered. Frank M. Mott, Myr., Oakland.

Pascagoula, Miss.—Bond issue of $85,000 for erection of bridge over Pascagoula river, near this city, will be voted on May 2. Address Co. Supvrs.

Albany, N. Y.—Plans and specifications will be prepared and bids procured from contracting firms to enable city to present plan and guarantee construction of proposed Great Western Gateway bridge at cost of about $700,000. This information will be used to defeat, if possible, plan for substitution of "2a" route bridge for one generally favored, known as Great Western Gateway, or route No. 1 bridge, at foot of State St. Plans being prepared by John A. Bensel, New York City.

Springfield, Ill.—April 19, until 11 a. m., for four reinforced concrete bridges in Putnam Co., Sec. D. Estimated cost, $2,190. Address Co. Supt. of Highways, McNabb, Ill.

BUILDINGS.

BIDS REQUESTED.

Fort Dodge, Ia.—Until April 18, for erecting County Home. Estimated cost, $48,000. E. O. Damon, Archt., Ft. Dodge. J. L. Hanrahan, Co. Aud.

Indianapolis, Ind.—May 2, until 10 a. m., for general construction of Tuberculosis Hospital at Oaklandon, Ind. Leo K. Fesler, Aud. Marion Co.

International Falls, Minn.—April 18, until 2 p. m., for constructing consolidated school building, installing heating, ventilating and plumbing system. Certified check 5 per cent. of bid. D. B. Jewell, Clk. Bd. of Educ.

London, O.—Until April 15, for erecting centralized school building. J. A. Jones & J. M. Maddux, Archts., 509 Dispatch Annex Bldg., Columbus, O. W. F. Glass, Clk. Bd. of Educ.

Portland, Ind.—April 27, until 9 a. m., for Jay Co. court house. John Bonifas, Co. Aud. McLaughlin & Hulsken, Archts., Lima, O.

Sharpsville, Ind.—April 18, until 11 a. m., for brick and stone school building for Liberty Twp., Tipton Co. J. L. Romack, Twp. Trus.

Summit, N. J.—April 15, until 8 p. m., for 4-room addition and other alterations to public school No. 11. Certified check 3 per cent. of bid. John D. Morgan, Vice Pres. Bd. of Educ.

West Liberty, O.—Until April 17, for erecting school costing about $75,000. Theo. Jones, Sec. Bd. of Educ. Proudfoot, Bird & Rawson, Archts., Des Moines.

CONTRACTS AWARDED.

Huntington, Ind.—To Wm. Everly, Indianapolis, Ind., general contract for construction of high school, at $153,930. To

PITTSBURGH PAVING JOINT

A permanently watertight and flexible expansion joint for concrete, stone, brick and wood block roadways and sidewalks. Made of Asphaltic compound, of the greatest flexibility, it is truly tough and pliable. It will bend without breaking and will therefore stand rough handling on the job.

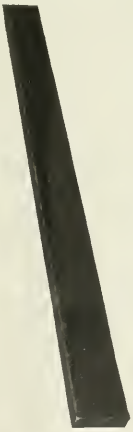
Will withstand exposure in hottest weather because of its high melting point (260° F.).

Showing the facility with which Pittsburgh Paving Joint can be laid. Note the absence of melting tank and other cumbersome apparatus

Because it is so evenly tempered in the process of manufacture it can be used in the coldest weather without danger of shattering or cracking.

Supplied in strips of standard lengths, thickness and width, "ready for laying" just as bricks are laid.

Requires no special fitting and cutting on the job. Eliminates the necessity for the "mussy" melting pot and other cumbersome accessories.



Its use permits the completion of each day's work as the work proceeds, thus facilitating supervision and inspection.

The Pittsburgh Paving Joint is the only joint combining all these advantages so essential to modern road building requirements.

See the Pittsburgh Paving Joint for yourself. We will gladly send sample and supply complete details.

Asbestos Protected Metal Co.
Pittsburgh
First National Bank Building

2020

Contracting News

Benj. S. Eddy. Indianapolis, Ind., heating contract for building, at $17,495.

LaFayette, Ga.—To Little-Cleckler Construction Co., Anniston, Ala., construction of Walker Co. court house, at $68,850.

San Francisco, Cal.—To J. S. Hannah, general contract for tuberculosis wing of San Francisco Hospital, at $213,773.

Tacoma, Wash.—Joe Hanson, 3210 N. 16th St., lowest bidder for general contract for 2-story reinforced concrete gymnasium building at Stadium, high school. Bid, $62,865.

Walla Walla, Wash.—A. J. McLean, Walla Walla, addition to high school building and 9th St. grade school building, bids, $101,566 and $46,740.

GARBAGE DISPOSAL.

Altoona, Pa.—Bond issue of $100,000 may be voted on soon, of which $50,000 would be for garbage disposal plant. S. H. Walker, Myr.

Elgin, Ill.—Following bids submitted for incinerator plant: O. A. Elliott, Springfield, $8,550; H. H. Wagner, Huntington, Ind., $7,950 and $8,850; Albert E. Kerr, Chicago, $16,530; Morse-Boulger Destructor Co., New York, $7,450, $8,250 and $8,450; De Carie Incinerator Co., Minneapolis, Minn., $11,500 and $8,500; Chas. F. Walthers, Hammond, Ind., $7,700 and $8,560.

Logansport, Ind.—Construction of reduction plant in city instead of incinerator plant as previously contemplated is being considered. Frank V Guthrie, Myr.

New Castle, Pa.—Municipal garbage disposal plant and system of collecting garbage is being considered. Probable expenditure, $50,000. C. H. Milholland, Cy. Engr.

Newport, Ky.—Garbage reduction plant contemplated. Probable cost, $35,000.

Providence, R. I.—City plans to erect $300,000 garbage reduction plant if council approves and authority can be obtained from general assembly to do so. Milton H. Bronsden, Cy. Engr.

LIGHTING.

Bemidji, Minn.—Establishment of White Way in downtown section of city is being urged by merchants. T. W. Swinson, Cy. Engr.

Blackwell, Okla.—Bond issue of $10,000 for extensions and improvements to electric light system will be voted on April 19. The Benham Engr. Co., Consult. Engrs., Oklahoma City, Okla.

Bone Gap, Ill.—Ordinance authorizing bond issue of $3,750 for municipal lighting plant passed at recent meeting. Bond issue will be voted on April 11. Address Village Bd.

Caruthersville, Mo.—Funds being raised by Commercial Club for installation of ornamental lighting system. John F. Bay, Frank Cunningham and J. S. Wahl, Mem. of Lighting Comm

Columbus, Ind.—Contract awarded the Sanborn Electric Co., Indianapolis, for electric light plant, at $15,986.

Crawfordsville, Ind.—Extensions and improvements to municipal light plant being considered. W. G. Murphy, Myr.

Dillon, Mont. Installation of 60 ornamental light standards and 60-watt lamps contemplated. Wm. E. Chapman, Cy. Engr.

Grand Rapids, Mich.—Installation of boulevard lights on business district of Fulton St. being urged by East End Improvement Asso. Geo. P. Tilma, Cy. Comp.

Kalamazoo, Mich.—Issuance of bonds for enlarging present municipal light plant is being urged by citizens. James B. Balch, Myr.

Lake Norden, S. D.—Bond issue of $20,000 for electric light and water plant voted recently. Address Cy Clk

Newtown, Hamilton Co., O.—Bond issue of $7,000 for construction of electric light plant may be voted on at April election.

Seattle, Wash.—Plans outlined for addition to Lake Union auxiliary steam power plant to cost about $250,000. Purchase of new boilers, installation of small steam turbine and generators and other improvements planned. Building to be of reinforced concrete. Daniel Huntington, Archt J. D. Ross, Supt Light & Power, will have charge of machinery plans.

Spokane, Wash.—Plans are completed for ornamental lighting system for Sprague Ave., Bernard to Madison Sts., to cost about $48,600. C. M. Fassett, Myr.

Waveland, Ind.—New street lighting plans being considered. Address Town Trus.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bartow, Fla.—Until April 18, for 240 miles highway to be constructed with brick, asphalt or asphaltic concrete. H. S. Jaudon Engr. Co., Engrs., Box 384, Bartow, Fla.

Bluffton, Ind.—April 15, until 2 p. m., for macadam street in Bluffton, to cost $6,-178.75; gravel road in Rock Creek Twp., to cost $2,013.32, and stone road in Rock Creek Twp., to cost $3,534.35. C. T. Kain, Aud. Wells Co.

Bucyrus, O.—Until April 25, for paving various streets. Bids will be received on various types of pavement. Jacob Leifer, Direct. Pub. Serv.

Elkhart, Ind.—Until April 15, for 5,000 sq. yds. sheet asphalt, 5,000 sq. yds. brick or clay block, 5,000 sq. yds. concrete and 11,500 sq. yds. gravel pavement; also 11,-500 sq. yds. concrete sidewalks and 40,000 lin. ft. comb. curb and gutter. L. M. Russell, Cy. Engr.

Falls City, Neb.—April 14, until 1 p. m., for constructing pavement in Dist. No. 16. Estimate on paving, surfacing, curbing and guttering, $13,618. On intersection paving, surfacing, curbing and guttering, $5,902. Certified check $500. Geo. Reichers, Cy. Clk.

Lincoln, Neb.—April 18, until 2 p. m., for grading and paving in Dist. No. 10, Lancaster Co. Work calls for 3-in. vert. fibre brick, Classes B and C. Estimated costs, Class B, $23,233; Class C, $17,146.50. Certified check $1,000. H. E. Wells, Co. Clk.

Los Angeles, Cal.—April 17, until 2 p. m., for improving Coast Blvd. with 5-in. oil macadam, length 2.57 miles. County to furnish oil and rock. Estimated contractor's price, $13,306.65. Address Bd. of Co. Supvrs.

Los Angeles, Cal.—April 17, until 2 p. m., for improving 4.01 miles of Pico Blvd. with 5-in. concrete pavement. Estimated cost, $29,159.15. Address Bd. of Co. Supvrs.

Marinette, Wis.—April 18, until 2 p. m., for 11,000 sq. yds. reinforced concrete pavement. A. L. Hillis, Cy. Engr.

Norfolk, Neb.—Until April 17, for paving and water extensions. Total expenditure, $180,000. Bids asked on all kinds standard asphalt and concrete pavement. H. H. Tracy, Cy. Engr.

North Vernon, Ind.—Until April 14, for 1,732 sq. yds. brick, bitulithic, asphaltic concrete, asphalt, concrete or water-bound macadam on Walnut St. Chas. W. Miles, Cy. Engr.

Sarasota, Fla.—Until April 20, for roads and bridge construction in Sarasota Venice Dist., to consist of 28 miles sand asphalt and 19 miles graded roads; also bridge over Sarasota Bay. Address Bd. Co. Supvrs.

Stevenson, Wash.—Until April 15, for constructing Clark Co. line, Cascade section of State Rd. No. 8. Chas. H. Nellor, Co. Aud.

CONTRACTS AWARDED.

Asheville, N. C.—To Noll Constr. Co., Chattanooga, Tenn., 3,000 sq. yds. sheet asphalt pavement on 8-in. concrete base, In West Asheville.

Anaconda, Mont.—To Clifton-Applegate, Spokane, Wash., asphaltic concrete pavements, at $36,156.

Baltimore, Md.—To American Paving Co., Baltimore, sheet asphalt pavement in Southwest Baltimore, at $1.35 per sq. yd. Total cost about $120,000.

Chicago, Ill.—The White Paving Co., Milwaukee, lowest bidder for 50,000 sq. yds. asphalt pavement of Cornelia Ave. system. Bid $1.72 per sq. yd.

Clear Lake, Ia.—To the Bryant Paving Co., Waterloo, Ia., 36 blocks asphalt pavement, at $1.75 per sq. yd. Contract calls for Trinidad pitch lake asphalt.

Elkhart, Ind.—To the Andrews Asphalt Co., Hamilton, O., asphalt pavement on Indiana Ave., at $57,949.

Forest City, Ia.—To J. S. McLaughlin & Sons, Red Oak, Ia., 20,000 sq. yds. sheet asphalt pavement, at $1.66 per sq. yd, and 16,762 lin. ft. curb and gutter, at 58 cents per ft. Theo. S. DeLay, Consult. Engr., Creston, Ia.

Goshen, Ind.—To S. S. Saxton Co., Chicago, Ill., 12 blocks asphalt pavement on 7th St., at $1.56 per sq. yd., or total of $46,516.12.

Hastings, Neb.—To Watts & Amerman, Salina, Kans., Trinidad Lake and Texaco asphalt pavement in 27 districts, at $1.46 per sq. yd.

Houston, Tex.—To Lester Levy, Dallas, Tex., paving of Harrisburg Blvd. from Houston city limit to La Porte Rd. in Harrisburg, with Texaco asphaltic concrete, at $141,927.50.

Indianapolis, Ind.—To Indian Refining Co., contract for supplying city with not less than 850,000 gals. road oil this year. Contract price, $1.62 for each 100 gals.

Logansport, Ind.—Palmer, Moore & Co., probable contractors for brick and concrete pavement on Erie Ave., from 5th to 12th St. (Local firm.)

Maysville, Ky.—To R. L. Schoolfield, Newport, brick paving, at $21,099; to Vastine, Nowland & Lowery, Covington, brick paving, at $43,472.

Mishawaka, Ind.—To H. W. Reed & Sons, Mishawaka, Ind., road construction in Penn Twp., St. Joseph Co., at $18,400.

Montesano, Wash.—To Nels Johnson, Hoquiam, Wash., East Hoquiam Rd. and Permanent Highway No. 12, Grays Harbor Co., at $24,331.39.

Muncie, Ind.—To I. G. Johnson, O. R. Davison Rd. in county, at $11,980; to Carey & Miller, John Madill Rd., at $9,740.

Muncie, Ind.—To J. G. Johnson, Lynn, Ind., Henry-Delaware Co. line Rd., at $11,980.

Olympia, Wash.—To Jarvis & Burkheimer, Seattle, graveling 7½ miles on Pacific highway, at $13,652.80.

Petersburg, Va.—To J. L. Perkinson, Petersburg, 10,000 yds. concrete sidewalks and 15,000 ft. concrete curb and gutter.

Tupelo, Miss.—To Hicks, Miller & Hicks, Birmingham, Ala., 16 miles gravel road and 14 miles graded road in county, at $55,275.

Ravenna, O.—To Seiple & Wolf, Youngstown, O., two bituminous macadam roads in Portage Co., at $42,302.72 and $56,812.61.

Redwood City, Cal.—To J. McReynolds, one section of Crystal Springs Rd., at $60,-199.47; to Eaton & Smith, one section of same road, at $14,913.60.

Ritzville, Wash.—To Carlson-Chindall Co., Spokane, Wash., Permanent Highway No. 2A, at $52,493.20.

Sioux City, Ia.—To P. C. Hanson & Son, about 13 blocks street paving on various streets.

CONTEMPLATED WORK.

Adams, Mass.—About $19,000 will be expended for brick or clay block pavements, and about $6,000 for concrete sidewalks. Work will be advertised in April. Henry C. Neff, Town Engr.

Alamosa, Colo.—26,000 sq. yds. gravel pavement, 700 sq. yds. concrete sidewalks and 2,000 lin. ft. comb. curb and gutter contemplated. Chas. M. Johnston, Cy. Engr.

Allentown, Pa.—54,100 sq. yds. sheet asphalt pavement and 6,040 sq. yds. bitumen. concrete pavement will be advertised between April 1 and 15. Chas. D. Weirbach, Cy. Engr.

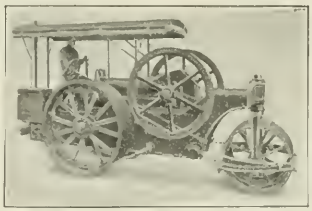
Billings, Mont.—Bond issue of $175,000 voted recently for road construction in Yellowstone Co. Bids will not be called before May or June. F. E. Williams, Co. Clk. Arthur Boyer, Co. Engr.

Blackwell, Okla.—Plans adopted for paving 21 blocks in business district with vitr. brick block pavement. Approximate cost of work, $110,000. The Benham Engr. Co., Consult. Engrs., Oklahoma City.

Bluffton, Ind.—Repaving of streets in business section agreed on by city council. Brick will probably be used. John Mock, Myr.

Columbus, Ind.—Petitions filed with Co. Commrs., asking for resurfacing of highway extending from 8th and California Sts. in this city thru Sandcreek Twp. Total length, about 6 miles. Estimated cost, $90,000 to $100,000. Address Co. Commrs.

Defiance, O.—Contracts will probably be let in about 60 days for paving Harrison, 3rd and Jackson Sts. About 29,550 sq. yds.



Modern Municipal Road Authorities

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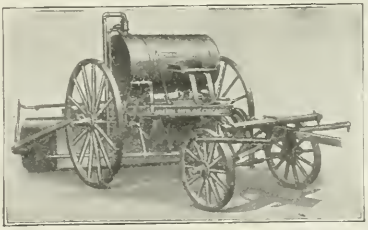


Contracting News

pavement required. Estimated cost, $95,-200. August Myers, Direct. Pub. Serv.

Dillon, Mont.—1,000 sq. yds. concrete sidewalks and 10,000 lin. ft. concrete curbing planned. Wm. E. Chapman, Cy. Engr.

Edinburg, Tex.—Bond issue of $250,000 for construction of Hidalgo's Co.'s portion of proposed Diamond Loop Highway will be voted on April 20. Address Co. Commrs. Hidalgo Co.

Everett, Wash.—Bids will be asked at once for proposed 16 miles concrete pavement between Everett and King Co. line at Bothell. Bids will be opened in about thirty days. W. C. Bickford, Co. Engr.

Idaho Falls, Ida.—Plans being made for about 10 miles concrete sidewalks in all districts. Chas. Chapin, Cy .Engr.

Indianapolis, Ind.—Specifications adopted for clearing, grading, curbing and constructing cement sidewalks along Pogue's Run on Brookside Parkway. Estimated cost, $18,459.25. Plans being made for improvement of East 16th St. B. J. T. Jeup, Cy. Engr.

Mandan, N. D.—Contract for 50,000 sq. yds. paving will be let early in April. Bids will be received on vitr. brick, wood block, bituminous concrete, 2-course, bitulithic and tarvia. Work calls for 5-in. concrete base and 12,000 ft. new and reset curb. Black & Griffin, Engrs., Mandan.

Morgantown, W. Va.—Bond issue of $300,000 for road improvements in Monongalia Co., Grant Dist., will be voted on April 15. A. D. Williams, Library Bldg., Morgantown, Ch. Rd. Engr.

Norfolk, Va.—Appropriation of $27,000 for improvement of four roads leading into city from Norfolk Co. approved. W. R. Mayo, Myr.

North Yakima, Wash.—City expects to lay bituminous concrete pavement with cement concrete base, concrete sidewalks, curbs and gutters. Amount not decided on. N. A. Gilman, Cy. Engr.

Paducah, Ky.—Resolutions passed for repaving Broadway from 1st to 4th Sts. with brick, asphalt or concrete; improvement of Jefferson St., 4th to 14th Sts., with brick or concrete and laying brick sidewalks in district bounded by 1st, 9th, Monroe and Washington Sts. L. A. Washington, Cy. Engr.

Palatka, Fla.—$80,000 bonds voted recently for hard surfacing road from Palatka to Orange Springs. Address Putnam Co. Commrs.

Paulls Valley, Okla.—Plans being made for about 10 blocks pavement in residence district. Paving of many other streets in residence district will probably follow in near future.

Walla Walla, Wash.—Resolutions being considered for about 50,000 sq. yds. additional pavement. W. R. Rehorn, Cy. Engr.

SEWERS.

BIDS REQUESTED

Binghamton, N. Y.—Until April 19, for Sec. 1 of intercepting sewer. Estimated cost, $150,000. W. Earl Weller, Cy. Engr.

Jacksonville, Fla.—April 14, until 8 p. m., for 18 miles sanitary and storm sewers, varying in size from 8-in. to 54-in. Certified check 2½ per cent. of bid. L. D Smoot, Commr. Pub. Works.

Jacksonville, Fla.—April 14, until 8 p. m., for furnishing material in connection with proposed construction of sanitary and storm sewers. L. D. Smoot, Commr. Pub. Works.

Wabasha, Minn.—Until April 18, for constructing sewers. J. F. Druar, Consult. Engr., St. Paul, Minn. J. M. Schouweiler, Cy. Rec.

Watertown, S. D.—April 17, until 7:30 p. m. for sewage pumping equipment including two centrifugal sewage pumps with motors, control equipment, etc. Certified check $200. Chas. Harman, Cy. Aud.

Xenia, O.—April 27, until noon, for sewer extensions and sewage disposal plant. Estimated cost $57,000. Certified check 5 per cent. of bid. J. P. Shafiker Cy. Engr.

CONTRACTS AWARDED.

Houston, Tex.—To Horton & Hutton Houston, storm sewers in Euclid Ave., from Westheimer Rd. to Buffalo Bayou, at $263,-994.50; to W. Waldo, Houston, storm sewers in Crockett St., from Hickory St. to Taylor St., at $21,149.50.

Macon, Ga.—To Turner & Mangham, Macon, installation of Vineville branch sewer, at $28,312.35.

Philadelphia, Pa.—To J. E. Brenneman, Philadelphia, extension of Indiana Creek sewer in 69th St., at $17,818.

Polson, Mont.—To Security Bridge Co., installat on of city sewer system. Estimated cost, $25,000.

Union, Ia.—To Cole Bros, Ames, Ia., installation of sewers in business district at about 70 cents per lin. ft.; to Ward & Weighton, Sioux City, Ia., disposal plant and outlet, at about $5,400. Work to be completed Sept. 1.

CONTEMPLATED WORK.

Adams, Mass.—$3,000 will be expended for 8-in. tile sewers and $2,500 for 30-in. block sewers. Henry C. Neff, Town Engr.

Beardstown, Ill.—Bond issue of $15,000 for constructing central sewer, pumping plant, etc., will be voted on in April. M. H. Harris, Myr.

Blackwell, Okla.—Bond issue of $18,000 for proposed sewer extensions will be voted on April 19. The Benham Engr. Co., Consult. Engrs., Oklahoma City, Okla.

Detroit, Mich.—Extension of Morrell St. sewer in Montclair, Bancroft, LaSalle, Calvert, 12th and Elmhurst Sts., will be advertised shortly. Estimated cost of work, $250,309.42. Mr. Fenkell, Commr. Pub. Works.

Dumellen, N. J.—Bond issue of $45,000 to complete local sewer system will be voted on April 26.

Greenville, Tex.—City proposes to construct 18 miles 6-in. to 15-in. sewer extension and sewage disposal plant. Total cost, about $80,000. A. D. Duck, Cy. Engr.

Harlowtown, Mont.—Bond issue of $25,-000 for installation of sewerage system will be voted on April 4. Geo. E. Baker, Consult. Engr., Whitehall, Mont. Dr. S. K. Campbell, Cy. Clk.

Itasca, Tex.—Bond issue of $15,000 for sewer system voted recently.

Lornin, O.—Contract will be let about July for sewer construction in Reid Ave. Estimated cost, $17,000. 1,200 ft. 12-in. vitr. pipe and 1,670 ft. 42-in. and 60-in. brick sewer required. C. M. Osborn, Cy. Engr.

Ogden, Utah—Preliminary plans being made for Third ward sewer system. A. R. Heywood, Myr.

Park River, N. D.—Installation of sewerage system voted on favorably at recent election. Mr. Cameron, Myr.

Pitman, N. J.—Resolution adopted providing for election on $110,000 5 per cent. bond issue for sewer system. C. G. Justice, Myr.

Puyallup, Wash.—Plans completed for trunk sewer for east end of town, to cost about $15,000. Drainage system, to cost about $31,000 to drain southeast section of city, proposed. Plans now being made. G. D. Ball, Cy. Engr.

Tulsa, Okla.—Plans adopted for Bellview sewer system. Probable cost of storm sewerage system, $86,300, and of sanitary sewers, $12,800. T. C. Hughes, Cy. Engr.

Venus, Tex.—Contract will be let shortly for sewer system and sewage disposal plant. Probable cost, $12,000. J. D. Carter, Consult. Engr., Dallas, Tex

Watts, Cal.—Bond issue of $125,000 for complete sewer system, including septic tank disposal system, will be voted on April 10.

STREET CLEANING.

CONTEMPLATED PURCHASES.

LaPorte, Ind.—Purchase of street sweeper this spring decided; kind not yet selected. David H. McGill, Myr.

St. Joseph, Mo.—Two street flushers will be purchased shortly. W. D. Morrison, Pres. Bd. Pub. Works.

WATER WORKS.

CONTRACTS AWARDED.

Idaho Falls, Ida.—To Wheelright Bros., Ogden, Utah, installation of water works system, at $21,492.

Milwaukee, Ore.—To Giebisch & Joplin, Rothchild Bldg., Portland, Ore., water works extension contract, at $15,896.85.

Salt Lake City, Utah.—To the Wheelwright Contr. Co., contract for water main extensions, etc., during year, at $85,060.50.

CONTEMPLATED WORK.

Blackwell, Okla.—Bond issue of $32,000 for water works extensions will be voted on April 19. The Benham Engr. Co., Consult. Engrs., Oklahoma City, Okla.

Bremerton, Wash.—Bond issue of $219,-000 for purchase of water system and making improvements voted. F. S. Hathaway, Cy. Engr.

Buffalo, N. Y.—Bond issue of $500,000 for water works system voted. Thos. W. Kennedy Supt. Water Works.

Chinook, Mont.—Bond issue of $10,000 for purchase of water system filter voted.

Clovis, N. Mex.—Plans being prepared for extensions and improvements to water works system. Estimated cost, $35,000. Burns & McDonnell, Engrs., Interstate Bldg., Kansas City, Mo.

Cohoes, N. Y.—Improvements contemplated to water works, including metering of supply pumps and improvements to water works station, and installation of electric-driven pumps. Jas. S. Calkins, Myr.

Colville, Wash.—Plans being made for installation of water works extensions, to cost about $10,000. Sawyer Bros., Consult. Engrs., White Bldg., Seattle.

Dundee, N. Y.—Water works system being considered. Committee will be appointed at once to investigate costs, etc. Dr. John S. Thompson is interested.

East Helena, Mont.—Co. Commrs. have been petitioned to issue bonds amounting to $15,000 for construction of water works system. Address Co. Commrs.

Elmira, N. Y.—Bids will be advertised, beginning next week, for steam turbine engine and centrifugal pump of 7,500,000-gal. capacity, to be installed in municipal pumping station. Address Bd. of Water Commrs.

Everett, Wash.—Bids will be called latter part of April or first of May for constructing pipe line and reservoirs for additions to city water system. First unit will cost about $560,000. Burns & McDonnell, Engrs. D. D. Merrill, Myr.

Gray, Me.—City plans to install water system. Estimated cost, $30,000. L. B. Hunt, H. Merrill and E. H. Lowe, Selectmen.

Lake Norden, S. D.—Bonds amounting to $20,000 voted for constructing water works and light plant. Address Cy. Clk.

North Tonawanda, N. Y.—Bond issue of $40,000 for improvements to water system carried at recent election. Benj. L. Rand, Myr.

Oakesdale, Wash.—Plans being prepared for water and sewer system to cost between $20,000 and $30,000. Sawyer Bros., Consult. Engrs., White Bldg., Seattle, Wash.

Pleasantville, Ia.—Petition asking for construction of municipal water plant being signed by citizens. Work would call for bond issue of about $20,000.

Renton, Wash.—Engineer will probably be engaged to investigate water plant, with view to recommending changes to enlarge it. G. A. Horner, Cy. Engr.

Sand Point, Ida.—Citizens will probably be asked to vote on matter of issuing bonds for construction of water system or purchase of local water works plant. Sawyer Bros., Consult. Engrs., Seattle and Spokane.

San Diego, Cal.—Contract will be let in April for furnishing material for 36-in. wood stave pipe line, between Dulzura Creek and Upper Otay, about 5 miles. Geo. Cromwell, Cy. Engr. H. M. Lockwood, Cy. Mgr.

Tuscola, Ill.—Bond issue of $18,000 for municipal water works carried at recent election. Mr. McMasters, Myr.

Twin Falls, Ida.—Construction of rock-filled dam with cement concrete core for proposed power plant, recommended by Engr. J. M. Burkett. Estimated cost, $10,000.

Waukegan, Ill.—Installation of water meters in city being urged. Ordinance compelling their installation will be introduced in council within short time. M. J. Donahue, Cy. Engr. E. V. Oris, Water Commr.

VOL. L. — No. 5.

Municipal Engineering

The World's Leading Municipal Publication

MAY, 1916.

WHAT IS AN ENGINEER?

A special committee of the American Society of Civil Engineers on Engineering Education has been working on its subject for several years. It has gone so far as to ask the members of engineering societies for their ideas of the fundamental characteristics necessary to success in engineering and to analyze the 1,500 answers to this question which it has received. The result thus far has been to classify these answers and to send out a second inquiry in which the groups of qualities are arranged in their order of importance as indicated by the vote. Thus character, including integrity, responsibility, resourcefulness, initiative, stands first with 41 per cent. vote, then in order, judgment, 17½ per cent.; efficiency; understanding of men; knowledge of the fundamentals of engineering science, 7 per cent.; technique of practice and of business, 6 per cent. Each voter is required to arrange these six qualities in the order of importance in his opinion as applied to an applicant for an engineering position. The idea seems to be that from these replies a formula for the product business and professional men want from a technical school can be made and then the schools will attempt to fill the demand.

The first six of these groups of qualities had 87 per cent. of the votes on the first ballot. The first three are not peculiar to engineers or to the product of engineering schools, but are what are necessary to the fullest success of any man in any business or profession. Their development should be the aim of every school of every kind, including engineering schools. The latter schools have sometimes been criticized because they had a tendency to neglect these qualities, and in so far it may be well to include them in the formula. The third group, efficiency, may well be emphasized from the practical point of view. Development in the first and second groups is the product far more of daily life and conduct than of school instruction, but neither should be lost sight of for a moment in the daily intercourse during school life, tho definite daily detailed instruction may be conspicuous, as it usually is, by its absence.

In short, the first and second groups are not peculiar to engineering schools, nor to schools in general, being rather the product of example and influence than of precept from outside, but mainly the product of the life of the young man of which his school life occupies but a small proportion after all.

The fourth group, the understanding of men, including executive ability, is again not greatly dependent upon definite instruction, but its development in the young man is induced by the practice of the art of doing things rather than the study of the science of doing them. So far as the latter study is concerned, it is an accompaniment of the study required to meet the requirements of the fifth and sixth groups and will aid the practice of the art of doing things, and as such should occupy a prominent place in the curriculum.

The six groups thus reduce, so far as the special work of the technical school is concerned to the last two, the scientific part of the fourth and the practical part of the third, these two being placed last because only the barest fundamentals can in any event be given during the college course. The first three are demanded of all educational activities of any kind whatever, and a technical school which is lacking in them is lacking in the first principles of an educational program. Any school lacking in them is not a true educational institution.

PAVED ROADS AND PREPAREDNESS

A large committee of engineers, with members from every state, has been appointed to make an industrial census to determine what the country has which could be made available on short notice in case of war. The civil engineers on the committee desire to extend the scope of the census to cover bridges and roads. We make room for an article by Major P. S. Bond, demonstrating the necessity of paved roads in modern warfare, more particularly along the probable battle fronts. As Major Bond says, we have the railroads, we have the automobiles, and we have the facilities and materials for making the necessary supplies and promptly renewing all these things as required.

But we do not have the roads. And roads take time to build. The conclusion is inevitable that the first step in a program of preparedness is the location and construction of the necessary roads. Everything else can be taken care of after war is declared, if necessary, but after war is declared, no adequate solution of the road question can be found. Fortunately, preparedness for war in the supplying of good roads is at the same time the best possible preparedness for peace, and even those who are crying for peace at any price cannot condemn such a step toward preparation.

If the engineers of the country will join with the army officers in a campaign on Congress for paved roads, they can put them thru. All that is needed is a pull altogether. Begin the campaign as individuals. Write to your representatives and your senators. Organization will soon follow.

SEWAGE TREATMENT PLANT

AT ROCHESTER, NEW YORK

The new sewage disposal plant at Rochester, N. Y., which will partially treat the sewage of that city in Imhoff tanks prior to discharging it into Lake Ontario, will be ready for operation some time this year. This brief description of the plant, taken from an article by C. Arthur Poole, C. E., general assistant engineer in charge of the sewage disposal plant, is timely and should give a clear idea of what is to date probably the largest installation using this method which has yet been constructed.

THE sewage of Rochester, N. Y., is collected from the main sewers of the city by an intercepting sewer and carried to a treatment plant in the town of Irondequoit, near Lake Ontario, the treated effluent being discharged thru an outlet pipe into the lake 7,000 feet from shore, where the water is 50 feet deep.

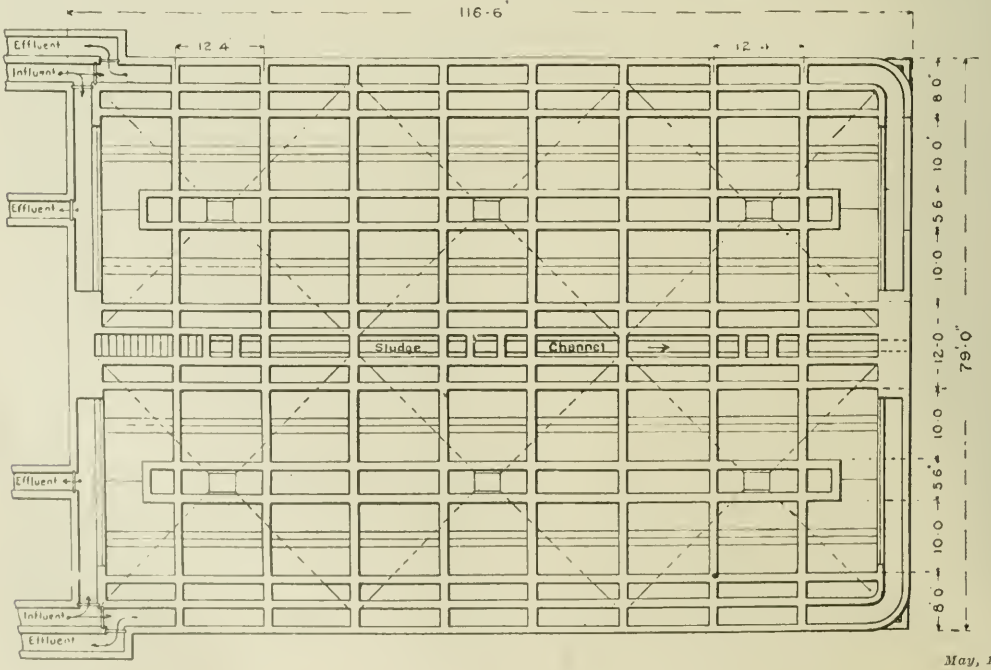
The intercepting sewer discharges the sewage into six detritus tanks arranged side by side, the entrance to each tank being provided with a coarse rack with 2-inch openings for rough screening. A gate at the entrance of each tank makes it possible to use at any time any desired tanks. Each tank is 90 feet long and 10 feet wide and has an effective depth of 3 feet, so that about 100 cubic yards of grit can accumulate before cleaning. An excavating machine does the cleaning mechanically, drainage being provided for during cleaning by a system of underdrains. At the outlet end of each tank is a revolving screen with ½-inch openings, mechanically cleaned, for a careful screening of the sewage before it passes to the main influent channel for distribution to Imhoff tanks.

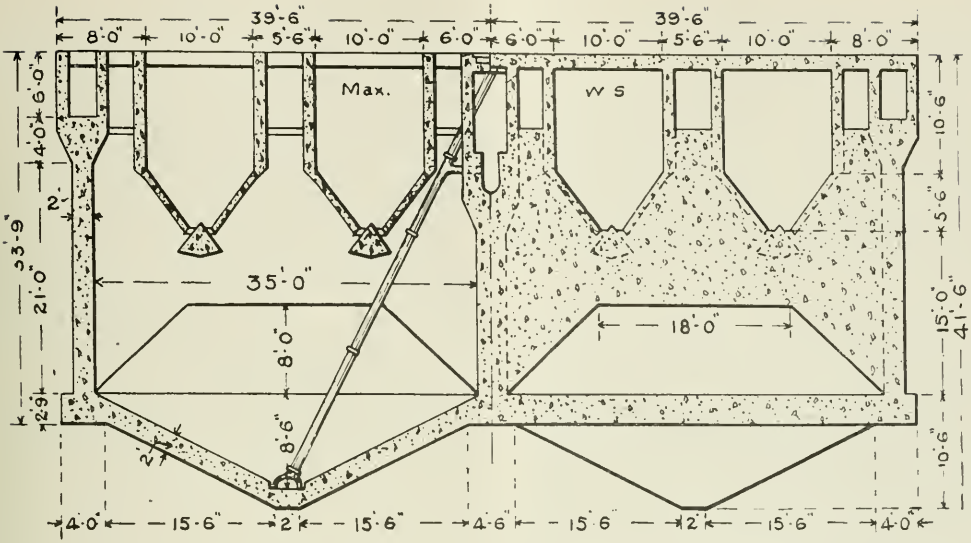
The plans provide for 10 Imhoff tank units, each with a capacity to handle the sewage from 40,000 people. As the population of Rochester is but 250,000 at present, only 7 of these units are constructed at this time, the others to be added as the growth of the city may demand.

Each unit is practically six Imhoff tanks, in two sets of three each, the sets being arranged side by side. The drawing of the plan of a double Imhoff tank shows the arrangement of the six tanks with the sludge channel running between the two sets of three each.

Five of the units are placed on each side of the main influent channel, which is about 395 feet long, each unit, as shown on the drawing, being 79 feet wide, measured on the line of the influent channel, the entire plant being about 435 feet long..

PLAN OF A DOUBLE IMHOFF TANK. SLUDGE CHANNEL RUNS BETWEEN THE TWO TANKS. EACH TANK HAS THREE HOPPER BOTTOMS AS SHOWN FOR COLLECTION OF SLUDGE AT ENTRANCE TO PIPE OUTLET, WHENCE THE SLUDGE IS RAISED THRU THE PIPE TO THE SLUDGE CHANNEL BY THE PRESSURE OF THE WATER IN THE TANK ABOVE. NOTE INFLUENT AND EFFLUENT CHANNELS AND STOP PLANKS, BY THE PLACING OF WHICH THE FLOW OF SLUDGE CAN BE CHANGED TO PASS THRU EITHER TANK IN EITHER DIRECTION.





CROSS SECTION OF DOUBLE IMHOFF TANK. THE SECTION OF THE LEFT TANK IS THRU THE BODY OF THE TANK, SHOWING THE SLOPING BOTTOMS OF THE DIVISIONS BETWEEN THE UPPER AND LOWER PARTS OF THE TANK; THE TRIANGULAR KEY IN THE OUTLET SLOT OF THESE SLOPING BOTTOMS, THE REINFORCING RODS IN WHICH SERVE AS TIES BETWEEN THE END WALLS OF THE TANKS; CROSS SECTIONS OF THE INFLUENT AND EFFLUENT CHANNELS, AND OF THE SLUDGE CHANNEL. NOTE ALSO THE OUTLET PIPE FOR SLUDGE DISCHARGE RUNNING FROM THE BOTTOM OF THE HOPPER UP TO THE SLUDGE CHANNEL, AND EXTENDING, FOR INSPECTION, CLEANING AND DILUTION PURPOSES, UP TO THE CENTRAL WALK BETWEEN THE TANKS.

Each tank in a unit is 110 feet long and 35 feet wide, with a maximum depth of 40 feet. With the various influent, effluent and sludge channels the outside dimensions of a unit shown on the drawing are made up, viz: 79 feet along the main influent channel and 116.5 feet perpendicular to it.

Sewage may be admitted to any tank by the operation of gates, admitting the influent sewage to channels around the pair of tanks in a unit. These channels are so arranged that the influent sewage can be admitted to either end of a tank and the effluent sewage discharged from the opposite end, making it possible to reverse the flow of sewage thru the tank. The alternative routes of influent sewage and of effluent sewage are indicated by the arrows on the drawing. This reversal of flow is desirable especially during the winter time when, sometimes, sludge can not be removed from the tanks for 150 days, so that the deposit of the sludge can be equalized over the entire area of the tank.

According to the usual designs for Imhoff tanks, the upper part of each tank is separated from the lower part by partitions with sloping bottoms which form in each tank two long parallel V-shaped troughs, each 10 feet wide and 12 feet deep at the center line, measuring from the surface of the water to the 6-inch slot at the bottom of the trough, thru which the matter settling out of the sewage standing above enters the compartment below in which this sludge is digested.

The drawing marked "Section of Double Imhoff Tank" shows a cross-section of the pair of tanks in a unit, the section of the left tank of the pair being thru the body of a tank and that of the right thru one of the supporting partitions carrying the troughs and roofs above. The troughs described above are shown, the sloping bottoms, 5 inches thick, being on an angle of 1 horizontal to 1⅜ vertical. The method of preventing the escape of gas from the fermenting sludge below thru the slot in the bottom of the trough is shown in the roughly triangular cross section of the concrete bar which shunts the sludge each way from the center as it is going down and turns the gas away from the slot as it passes up thru the water. Between the troughs is a gas slot 3 feet wide into which the gas rises from the sludge below.

This lower section of each tank has three hopper-shaped depressions in its bottom, each 35 feet square at the top and 8 feet deep, the hopper bottoms being 15 feet below the slot in the bottom of the upper section of the tank. This volume of space gives storage for 40,000 cubic feet of sludge or 20,000 people for each tank of a pair, which will be sufficient for the 150 winter days above referred to, on the basis of 2 cubic feet of sludge from each person in that time.

The flow of sewage from the main influent channel into the channel serving each unit will be automatically controlled at any rate desired by means of an adjustable float in the influent channel. The change in direction of flow into the individual tanks will be made by hand.

The clarified effluent from the tanks flows to the main effluent channel, which runs parallel with the main influent channel. The dry-weather effluent flow passes into a 48-inch pipe which carries it to the power station in the plant where it has fall enough before reaching the level of the outlet pipe to the lake to generate power with which to light and operate the plant. The storm flow overflows directly into the outlet pipe to the lake.

The sludge which gathers in the hoppers in the bottom of the Imhoff tanks is drawn off thru pipes which discharge into a channel about 5 feet lower than the water surface in the tanks, head enough to force the sludge out thru the pipes. The sludge channel is located between the two tanks in a pair as shown on the plan and also in the sectional drawing. This channel takes the sludge to the drying beds, which have an area of one square foot for each three persons of the city population. These beds have 19 inches depth of filtering material laid in layers of graduated sizes of material and one under-drained with 3-inch tile, laid 18 feet apart. The beds are

in sections each about 40 feet square. Depressed tracks running lengthwise of the beds between sections supply car service for removing the dried sludge.

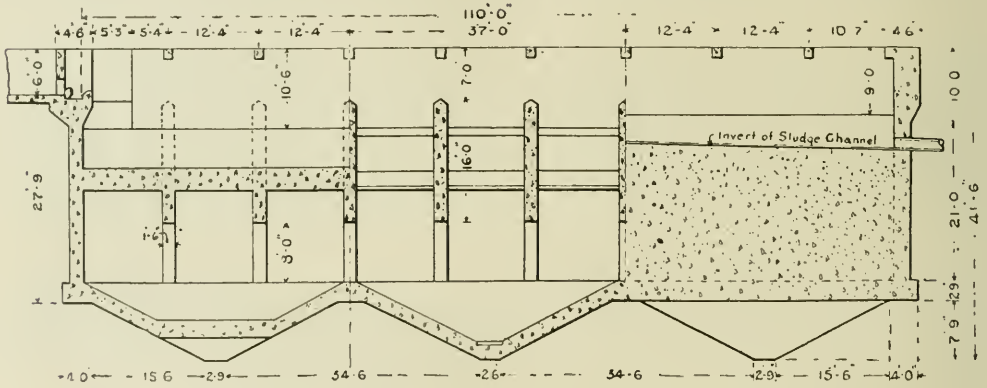
The outside walls of the Imhoff tanks proper are 2 feet thick, designed to resist an earth pressure from backfill to top of wall on the outside and a maximum depth of 27 feet of water on the inside. There is one of the transverse walls shown in the cross section of the right-hand tank in the drawing every 12 feet 4 inches, cutting the outside wall into panels. These 18-inch transverse walls carry the troughs, etc., above and serve as buttresses against outside pressure and ties against that from the inside. In the side walls at each transverse wall are placed two 10-inch channels, 24 feet long, acting as pilasters. Six 1¾-inch tie-rods in the transverse walls, attached to these pilasters, tie the side walls together. End walls are tied together in like manner, the tie rods running from end to end of the tanks in the triangular concrete sections located in the slots at the base of the sloping bottoms of the upper part of the tanks. Horizontal reinforcement in panels is ¾-inch, bars closer spaced toward the bottom of the wall. The middle longitudinal wall between the two tanks is 30 inches thick, reinforced to carry water pressure with either tank full and the other empty.

It will be noted that all the tanks are rectangular in form.

The entire structure is waterproofed by the integral method using Trus-Con waterproofing paste, 6 pounds to each cubic yard of concrete. The paste is diluted with water 1 to 1 and then put on the aggregate in the mixer just before the water is turned in. It is thus thoroly mixed in the concrete.

The work is well under way and promises to be near completion at the end of this season.

The plant was designed under the supervision of E. A. Fisher when city engineer and the late Emil Kuichling, consulting engineer. The construction is under the immediate charge of C. Arthur Poole, general assistant engineer for the sewage plant, to whom we are indebted for data. Myers and McWilliams, Rochester, N. Y., are the contractors.



LONGITUDINAL SECTION OF IMHOFF TANK. THE LEFT ONE-THIRD OF THE SECTION IS THRU THE TANK AT A POINT TO SHOW THE GENERAL LOCATION OF CROSS SUPPORTING WALLS AND VERTICAL SECTION OF THE SLOPING BOTTOM OF THE UPPER DIVISION OF THE TANK. THE MIDDLE ONE-THIRD IS TAKEN ALONG THE CENTER LINE, SHOWING THE HOPPER BOTTOM AND THE LOCATION OF THE SLOT IN THE SLOPING BOTTOM OF THE UPPER DIVISION, AND SECTIONS OF THE CROSS SUPPORTING WALLS. THE RIGHT ONE-THIRD IS TAKEN THRU THE WALL BETWEEN THE TWO TANKS OF THE PAIR AND SHOWS THE LONGITUDINAL SECTION OF A PART OF THE SLUDGE CHANNEL. THE DIMENSIONS ARE SELF-EXPLANATORY.

Reproduction Cost as Purchase Price of Water Works

For the first time, so far as is known in the history of New England water works systems, the price to be paid by the city of Bath, Me., to the Maine Water Company is less than the estimated reproduction cost of the plant. The price is $539,500, nearly $2,000 less than the reproduction cost, as determined by the joint conference of the engineers representing both sides.

This price was agreed upon by two engineers, Mr. Frederic H. Fay, of Fay, Spofford & Thorndike, consulting engineers, Boston, Mass., and Mr. William B. Getchell, of Augusta, Me., selected as the two arbitrators by the Bath Water District and the Maine Water Company, respectively, with power to choose a third arbitrator in the event of a disagreement. These two engineers, however, came to an agreement without the necessity of calling in the third man. Both parties to the contract are satisfied and all litigation expenses have been avoided.

The unusual feature of this transaction, aside from the business-like manner in which it was conducted, is the relation of the price to the reproduction cost of the plant as already pointed out. As will be noted in the following table, the usual purchase price for water systems thruout New England has been on the average one and a half times the reproduction cost:

Place	Reproduction Cost	Award	Ratio, award to reproduction Cost
Gardiner, Me.	$ 132,000	$ 245,000	1.85
Waterville, Ma.	368,546	503,475	1.37
Augusta, Me.	287,279	427,135	1.48
Kittery, Me.	102,510	163,869	1.60
Livermore Falls, Me.	85,394	117,698	1.38
Portland, Me.	2,853,696	3,963,034	1.38
Gardner, Mass.	165,000	274,000	1.66
Athol, Mass.	206,386	316,500	1.53

Wood Blocks for Street Paving

THEIR TREATMENT AND HANDLING

Treatment of wood blocks for use in street paving has not yet been standardized. Two societies, one of wood block manufacturers and one of municipal officials, have been at work on the problem for several years, and no specifications have been adopted by either one as yet. The comparison in this article of the specifications under consideration by these societies with modifications proposed by others and with the Toronto specifications covers all the various classes of oil in use and may help to clarify the situation. Suggestions and discussions are invited.

THE American Society of Municipal Improvements has just issued a booklet containing the specifications for wood block paving presented by its special sub-committee at the convention held in Dayton, Ohio, last October. The specifications were subject to considerable discussion, partly as to the report itself and more fully in the discussion of papers on the subject by E. P. Dutton, chairman of the committee, J. W. Howard, P. C. Reilly and H. Von Schrenk. As full agreement was not reached the specifications were not adopted and were laid over for consideration at the convention to be held in Newark, N. J., October 9-13, 1916. At the same time an invitation was extended to those interested to send in suggested changes in or modifications of the specifications for oils with which to treat the blocks. The booklet contains, in addition to the report of the committee, such suggestions from P. C. Reilly, president of the Republic Creosoting Co.; W. H. Fulweiler, chemist of the United Gas Improvement Co.; C. N. Forrest, chemist of the Barber Asphalt Paving Co., and J. W. Howard, consulting engineer on roads and pavements.

The city of Toronto, Ont., purchases treated wood blocks ready for laying in pavements, and either lays them by city-employed labor or lets the contract for laying them together with that for grading and foundation. Bids for the year 1916 were received in December on specifications which differ in some respects quite materially from any of those in the booklet referred to, particularly with respect to the oil for treating blocks.

It will be worth while to compare these specifications and such a comparison follows, the data being arranged so as to make the comparison as easy as possible. It should be stated that the same report presented to the American Society of Municipal Improvements was later presented to the Wood Preservers' Association and was not adopted by that organization but was ordered printed as information. Discussion of the data here presented is invited and suggestions of other specifications than those given may be made with such reasons for the differences as seem pertinent and such data as form the basis for the suggestions so made. Data as to cost of the treated blocks ready for laying, with full data as to oils used, methods and results of treatment are also invited for comparison.

Specifications for Preservative.

In the following reference letters are used for the authorities as follows:

A—Sub-committee of A. S. M. I.
B—P. C. Reilly.
C—J. W. Howard.
D—R. C. Harris, Commissioner of Works, Toronto, Ont.
E—W. H. Fulweiler.
F—C. N. Forrest.

DESCRIPTION OF OIL.

A—Wholly derived from coal gas tar or coke oven tar.

B—Obtained by the distillation of coal tar and consisting wholly of such distillate from coal tar as will comply with the following requirements.

C—Distillate made from coal-tar or a combination of distillates from coal-tar and water-gas tar, provided the oil produced meets all the tests of qualities needed for thoroly preserving wood stated below.

D—Pure coal-tar creosote, consisting of any and all distillate oils boiling above 170° C., which are obtained by straight distillation of coal tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids. It shall be free from all adulteration and shall not contain any tar, oil or residue obtained from petroleum or any other source, including coal-gas tar or coke-oven tar.

E—Product of water-gas tar and free from admixture of other crude or unrefined tars.

F—Refined water-gas tar complying with following requirements.

SPECIFIC GRAVITY AND DISTILLATION FRACTIONS.

Authority.	Sp. Gr. 38°C	Distillation Fractions—(Percentages) 0-200°	200-210°	210-235°	235-315°	315-355°
A	1.06—1.12	a5	....	30—	35—70	65+
B	1.12—1.14	b	b	b	15—	40—
C	1.03+	c5	....	....	.....	....
D	1.03—1.07	2	3	5—30	40=	25—55
E	1.11—1.14	d3	....	10—	40—	25+
F	1.12—1.14	a5	....	15—	40—	25+

= following figure indicates more or less.
— following figure indicates maximum permissible.
\+ following figure indicates minimum permissible.
a 0° to 210° not more than 5%.
b 0° to 250° not over 1%.
c 0° to 150° not over 1%.
d 0° to 210° not to exceed 3%.

OTHER REQUIREMENTS.

Insoluble with benzol and chloroform: A, 3—; C, 1—; E, 2—; F, 2—.

Specific gravity of distillate at 38°C: Between 235° and 315° C; A, 1.02—; E, 0.96—1.00. Between 315° and 355°C, A, 1.08—; F, 1.00 for total below 355°C. Between 400° and 420°C; B, 1.12—.

Specific viscosity at 82°C.: A, 1.3—.

Water content: A, 3—; D, 2—; F, 2—.

Foreign matter: A, not more than 2% of sawdust, dirt, etc., and for such and for water and benzol and chloroform insoluble, corresponding increase in weight of oil injected into block; D, same; F, same.

Residue above 355°: B, of soft waxy nature and not less than 1.17 sp. gr. at 25°C; yellow amber color of spot by transmitted light when absorbed by white filter paper. C (above 315°) soft and easily indented by finger. D, soft and adhesive if more than 5%.

Loss by evaporation: B, not more than 5% in 72 hours at 49°C. in open tin box 2½-in. diameter, ¾-in. depth, 25 grams weight.

Waterproof, antiseptic: C, waterproof, antiseptic, at least 10% of crystallizable naphthalene and 15% of stable anthracene oil.

Sulphonation test: D, no oily residue insoluble in caustic alkalies when test is applied to fraction between 305° and 320°C.

Caustic soda test: D, creosote shall yield not less than 8% by volume of tar acids to a solution of caustic soda.

Specifications for Treating Blocks.

The following description of the method of treatment is from the Toronto specifications (D) and is similar to but slightly fuller than in the A. S. M. I. report (A). Where A differs from D, the provisions of A are given in parenthesis:

The blocks shall be placed in an approved retort in properly constructed cages and heated with live steam to a temperature of not less than 180°F. and not more than 240°F. (A, 220° to 240°) for a period of at least two hours. During this period the condensed steam, etc., shall be drained off at intervals and at the end the retort shall be blown out and the steam allowed to escape; then a vacuum of not less than 24 inches (A, 20 inches) shall be applied for 1½ hours (A, at least 10 minutes) and, after draining retort, a further vacuum for ½-hour (A, omitted) the temperature in the cylinder being maintained during vacuum at approximately 180°F. (A, blocks maintained at 150° to 240°). The cylinder shall then be filled with the specified oil at a temperature of not less than 180°F. nor more than 190°F. (A, 180° to 200°) without breaking vacuum, and pressure shall be applied and gradually raised during a period of 2½ hours or for a sufficiently longer period to insure that all blocks shall contain after treating an average of 14 pounds (A, 18 pounds) preservative as specified herein per cubic foot of wood. (A, supplemental vacuum with or without steam may be applied). During this period the temperature of the oil shall not be allowed to fall below 165°F., and on completion the free oil may be pumped from the cylinder.

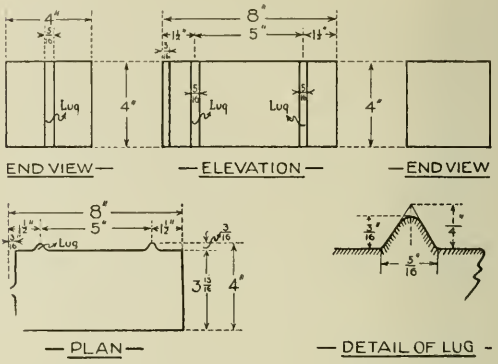
Upon completion of the treatment charges shall be allowed to remain in the cylinder from 30 minutes to 1 hour at temperature of 165°F. (A, omitted.)

(A, has additional: Not more than 10% excess over the 18-pound specified shall be allowed. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the sap-wood must be thoroly treated thruout. To determine this, at least 25 blocks from each charge shall be cut up and if more than 4% of the blocks shows untreated sap-wood, the charge shall be re-treated or rejected. After re-treating, the charge shall be again subjected to the same inspection. The surface of the blocks after treatment shall be clean and free from any deposit of oil or foreign substance. All blocks that are imperfect or that have been injured in the process of treating shall be rejected.)

Handling Blocks After Treatment.

The committee of the A. S. M. I. considers the method of handling blocks from time of treatment to time of laying in the street of great importance and provides as follows:

After the blocks have been treated and before they are laid, care must be taken to protect them as much as possible from drying out. They must at all times be closely piled when stacked on the street. All blocks must be thoroly wet, either while piled on the street before laying or while being laid, as directed by the engineer.



Toronto received bids on two forms of blocks. One form is rectangular with depth, parallel to the fiber of 4 inches, width 3 inches and length 6 to 10 inches with variations of not more than $\frac{1}{16}$-inch in width or depth. The other form has two ribs or lugs on one long face, and one rib or lug on one end, in each case parallel to the fiber, as shown in the accompanying drawing. The depth of block is 4 inches, width 4 inches to outside of lug and length 8 inches to outside of lug, the ribs projecting $\frac{3}{16}$-inch from the body of the block. Variations in dimensions are permitted if not more than $\frac{1}{4}$-inch in width or depth or more than $\frac{3}{16}$-inch in length.

Contract for these blocks was let at the following prices:

The committee of the A. S. M. I. recommends blocks of 3 to 4 inches width, all blocks used in the same city block to be of the same uniform width; 5 to 10 inches length, averaging 8 inches; and depths of 4 inches for heavy traffic streets, 3½ inches for medium to light traffic streets, and 3 inches for light traffic street, length of blocks in the last case to be not more than 8 inches.

A MODERN GRANITE PAVEMENT IN PHILADELPHIA.

East Grand Boulevard, Detroit, Michigan, showing artistic lamps and lamp posts and their effective distribution.

The Municipal Lighting Plant

OF DETROIT, MICHIGAN

SOME account of the lighting plant of Detroit, Mich., which gives the excellent results stated in the article on page 128 of the April number, will be of interest.

All of the electrical energy required for the operation of the Detroit Public Lighting Plant is generated in the main station at 40 East Atwater St. The current supply is 2-phase, 2,300-volt, 60-cycle.

2554 lamps are connected to the main station. The balance of the arc lighting service is from five substations. For the latter the potential is stepped up, at the main station, to 5,500 and 6,600 volts. There are also two transformer stations; one in Belle Isle Park, the other in Palmer Park.

For Belle Isle Park, a 3,600-volt, 3-phase feeder furnishes the power for the incandescent lighting and motors. In Palmer Park, the transformer station serves the incandescent lighting and 27 6.8-amp. series arc lamps. From four of the substations 2147 6.8-amp. series arc lamps are supplied, and from five of the substations 3007 4-amp. and 485 6.6-amp. luminous arcs are operated.

For the incandescent lighting and power required at those public buildings in the territory adjacent to the substations, the 5,500-volt potential is stepped down to 2,200, the same as that of the mains from the generating station.

From the main station and each of four of the substations, a patrolman with horse and buggy inspects those lamps located in his territory immediately after the arc circuits have been started, and also attends to any outside trouble that may develop during the evening.

The property controlled by the Public Lighting Commission now consists of the following:

Main Station.—The power house and office building, has a frontage on Atwater St. of 213 feet; 163 feet of which extends back an average of 318 feet 6 inches to the river front, and 50 feet of which on the east extends back only a distance on an average of 68 feet. At Atwater and Randolph Streets is a building for offices, storeroom and shops with frontage on Atwater St. of 80 feet, on Randolph St., 48.34 feet.

Five substation are located upon property owned by the city as follows: Thirty feet in the south side of Custar Ave., between Beaubien and St. Antoine Sts. Thirty feet in the south side of Newberry St., between Campbell and Junction Aves. Thirty feet in the west side of Beals Ave., between Mack and Goethe Aves.; Sixty feet in the west side of Lawton Ave., south of Warren Ave.; thirty feet, 171 feet deep, in the south side of Palmer Avenue, between McDougall and Elmwood Avenues. Upon the first three lots are brick buildings 30 ft. by 40 ft., with concrete floors. During the past year, fireproof additions have been built to these three substations, and the roofs over the old parts have been replaced by tile and concrete roofs, thus protecting the substations against the hazard of fire from adjacent buildings. The building in Custer Avenue is now 30 ft. by 116 ft. 3 in.; the one in Newberry Street 30 ft. by 102 ft. 7 in.; and the one in Beals Avenue 30 ft. by 81 ft. 10 in. The substation in Lawton Avenue is 36 ft. by 60 ft. 4 in.; and the one in Palmer Avenue 30 ft. by 104 ft. 4 in. These buildings are also fire-proof, with pressed brick fronts, cut stone trimmings and reinforced floor and roofs.

The pole yard for the west end of the city fronts for 372 feet upon Stone St. and is adjacent to the tracks of the Wabash R. R. For the east end of the city, the new yard fronts for 81.94 feet on Hart Ave. It is 316.75 feet deep, to the tracks of the Detroit Terminal R. R., upon which it adjoins for a distance of 193.09 feet.

The boiler house contains four 30-h. p. double-deck tubular boilers, C. C. Peck design, with Hawley down draft furnaces; one 300-h. p. Wickes vertical water tube boiler with Detroit stoker; three 400-h. p. Wickes vertical water tube boilers with Taylor stokers and Foster super-heaters; and two, Class O, No. 16, Sterling water tube boilers with Taylor stokers.

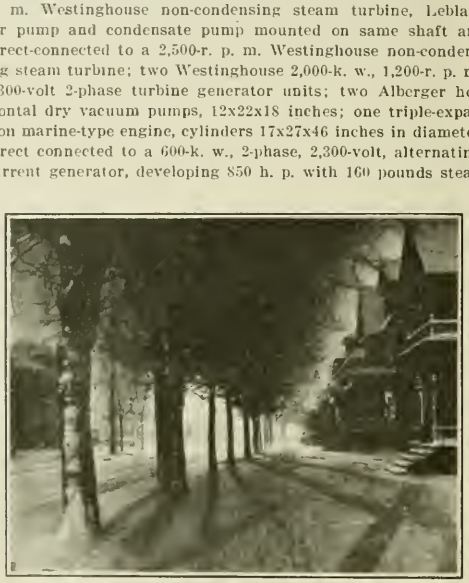
Coal for boilers with stokers is weighed and fed from an overhead steel bunker of 1,200 tons capacity. This bunker is filled from a Link-Belt conveyor in conjunction with coal crusher and conveyor from track hopper. Coal for the other boilers is handled in 1-ton charging cars on a Hunt industrial railway, from bins adjoining the firing floor. The capacity of these bins is 960 tons.

A side track, built by the Commission, in Atwater street, and connected with the railway tracks at Riopelle street, allows cars of coal to be placed alongside and unloaded directly into coal bins or a track hopper conveyor. The Commission has its own track scales and all contract coal is paid for on "out weights."

The Pump Rooms contain: One fire pump, capacity 1,000 gallons per minute; one 10x5x10-inch and one 14x8½x10-inch Worthington duplex boiler-feed pump; one 10x7x15-inch Platt duplex boiler-feed pump; one Worthington jet condenser that will condense 50,000 pounds of steam per hour, feed pump attached; two Alberger barometric condensers, each one con-

densing 50,000 pounds of steam per hour; one centrifugal pump connected to a 12x20x12-inch Westinghouse vertical compound engine; one 3,500-h. p. Cochrane receiver-type feed-water heater; two Westinghouse air compressors which supply air for cleaning apparatus; one Jeanesville 3-stage centrifugal pump connected to a Kerr turbine, with a capacity of 300 gallons per minute.

The engine room contains the following: One Westinghouse 5,000-k. w., 1,800-r. p. m., 60-cycle 2,300-volt two-phase turbine generator unit, connected to a Westinghouse surface condenser, which has a cooling surface of 8,000 sq. ft., condenser equipped with a Westinghouse-Leblanc air pump, an 8,000-gal. centrifugal circulating pump and a centrifugal condensate pump, circulating pump direct-connected to a 1,200-r. p. m. Westinghouse non-condensing steam turbine, Leblanc air pump and condensate pump mounted on same shaft and direct-connected to a 2,500-r. p. m. Westinghouse non-condensing steam turbine; two Westinghouse 2,000-k. w., 1,200-r. p. m., 2,300-volt 2-phase turbine generator units; two Alberger horizontal dry vacuum pumps, 12x22x18 inches; one triple-expansion marine-type engine, cylinders 17x27x46 inches in diameter, direct connected to a 600-k. w., 2-phase, 2,300-volt, alternating-current generator, developing 850 h. p. with 160 pounds steam



McGraw Avenue, east of Grand River Avenue, Detroit, Michigan, photograph taken at midnight, showing the efficiency of street lighting with ornamental lamps in amount and uniform distribution of light.

pressure and 26-inch vacuum at 120 r. p. m.; one three-line, triple expansion, center-valve, Willans engine, cylinders 13 7/16x20 7/16x32 inches in diameter, with 13 7/16 inches stroke, developing 800 h. p. with 160 pounds steam pressure, and 26 inches of vacuum at 277 r. p. m., direct-connected to a 600-k. w., 2-phase, 2,300-volt, Stanley alternator. Exciter units are one 60-k. w. Northern Electric 125-volt generator, direct-connected to a 100-h.p. center-valve Willans engine at 450 r. p. m; one 40-k.w. Northern Electric 125-volt generator, speed 325 r. p. m., direct-connected to a 100-h.p. Willans engine; one 60-k.w. Westinghouse 125-volt generator, direct-connected to a 100-h.p. Willans engine, speed 450 r. p. m.

In addition to the generators, the following alternating current apparatus is installed at the main station: Two 75-k.w. Western Electric step-up transformers; one 50-light G. E. mercury-rectifier arc-lighting regulator; thirty-nine 75-light G. E. mercury-rectifier arclighting regulators; five 350-k.w., oil-insulated, water-cooled, 2,200 to 5,500 transformers; three 750-k.v.a., oil-insulated, water-cooled, 2,200-volt, 2-phase, to 5,500-volt 3-phase transformers; six k.w., oil-insulated, water-cooled, 2,200-volt, 2-phase, to 6,600-volt, 3-phase, transformers; two 200-k.w., oil-insulated, self-cooling, 2,200-volt, 2-phase to 3,300-volt, 3-phase transformers; seven 150-k.w. 2,200 to 5,500-volt, oil-insulated, self-cooling transformers, three fitted up with regulating heads, in order that the voltage delivered may be regulated for any incandescent load operated from these transformers; two 50-k.w., 2,200-volt, 2-phase to 3,500-volt, 3-phase, oil-insulated, self-cooling transformers; one 100-k.w. 6,600-volt, 2-phase, induction-type feeder regulator for automatic operation; one 40-k.w., 2,200-volt, 2-phase, induction-type feeder regulator for automatic operation; one 33-k.w., 2,200-volt, single-phase, induction-type feeder regulator for automatic operation; one 45-k.w., 6,000-volt, single-phase, induction-type feeder regulator for automatic operation.

The apparatus at the substations consists, in addition to the switchboards, of: Thirty-five 60-light and fifteen 75-light inductance type arc circuit regulators; six 150-k.w. 5,500 to 2,200-volt transformers; three 150-k.w. 6,600 to 5,500-volt, oil-insulated, self-cooling transformers; four 30-k.w. 5,500 to 2,200-volt transformers; nine 75-k.w. 5,500 to 2,200-volt transformers; three 37½-k.w. 5,500-5,500-volt transformers, used to isolate an a. c. arc circuit, when in trouble, from the substation bus; fifty-four 4-amp. General Electric mercury-rectifier arc lighting regulators; eleven 6.6-amp. General Electric mercury-rectifier arc lighting regulators.

There are 1,566.11 miles of copper wire in the system, strung on 25,783 poles, of which 16,999 belong to the commission, 8,241 to the Edison Illuminating Company, 413 to the fire and police departments and the remainder to telephone, telegraph and street railway companies, who use in return the poles of the lighting system in about equal numbers, except that the fire and police departments use nearly 1,400 of the electric light poles.

There are 337,868.5 feet of electric conduits, of which 106,340 feet have two ducts, 101,560 have four ducts, 40,712 have seven ducts, 34,496 have nine ducts, and the remainder various numbers of ducts up to twenty-eight. There are also some 337,000 feet of single-duct laterals, about half 3½-inch vitrified clay tile laid in concrete, one-third 3-inch wood pump log, and the remainder 2½-inch iron pipe. The department uses 1,493 feet single-duct of Edison Illuminating Company's conduits, and they use 4,495 feet of the department conduits, including double and single ducts. The fire and police departments use some 7,000 feet of the electric light department conduits. Rental for use of conduits is charged at 5 cents a foot per annum for single duct, 9 cents for two parallel ducts and 12 cents for three.

The 700 acres of Belle Isle Park require two-thirds of the wooden conduit, all the park light wires being underground.

Detroit was one of the cities which installed tall steel frame towers for supporting groups of electric lights in the earlier days of electric lighting. When the public lighting plant was put in operation in 1895 there were 137 of these towers in use. The number has been reduced to 22 3-light and 21 4-light towers, which will ultimately disappear, the only high lights to remain permanently to be four on the standpipe in the water works park, which serve as a beacon to boats crossing the Detroit river.

As shown in last month's article, about 30 per cent of the street lamps now in use are single or double-light ornamental posts. One of the accompanying photographs shows the unobtrusive and decorative appearance of these lamps on East Grand boulevard, the posts shown being of the Broadway design, made by the Geo. Cutter Company, South Bend, Ind. Another photograph, which was actually taken just as shown, at midnight, shows the large volume of light supplied by the lamps and the even distribution of light due to the effective placing of the posts.

East Grand Boulevard, Detroit, Michigan, a notable thorofare paved with sheet asphalt laid by the Municipal Asphalt Plant Department.

Streets and the City Beautiful

By D. T. Pierce, Philadelphia, Pa.

A very large proportion of the area of every city is covered by streets, including pavements, sidewalks, lawns and park spaces. Their design and construction therefore, have a predominating influence upon the appearance of the city as well as upon its convenience of use of them. This article points out the lines to which attention must be paid and the physical and business as well as esthetic value of proper street design with some beautiful examples of proper treatment of the problem.

Water supply, sewers, lighting, transportation and paved streets are, by common consent, the five essentials to the health, comfort and general welfare of a municipality. The progressive community, however, is seldom content with mere essentials or bare necessities. Having obtained a lighting system that will partially illuminate its thoroughfares, it in time demands ornamental lighting systems in place of a glaring arc light on a hideous pole. Having got pavements which keep the inhabitants out of the mud, it soon demands not merely passability, but beautification.

This development is rapidly progressing in American municipalities because no single phase of the city beautiful movement accomplishes so much in so short a time as does the building of attractive boulevards and streets. Given all else implied by the term, and a town without attractive streets would never reach the status of the city beautiful. The importance of this feature of municipal improvement is illustrated by the accompanying views of notable boulevards. The beautiful street is the framework of the whole city beautiful proposition.

Some towns have gained distinction because of a single beautiful street, while others have established boulevard systems of world-wide celebrity. Whether one's first impression of a town is favorable or unfavorable is governed largely by the appearance of the streets.

Beautiful streets need not be restricted to large cities. Many quite small towns have been successful in utilizing very slender resources to the highest advantage. The photographs here reproduced of Main street, Marshall, Mich. (a town of 4,300 population), and Winterset, Ia. (with only 2,800 people), demonstrate that big cities have no monopoly of attractiveness, whatever they may claim as to mere size.

In the planning of city boulevards the best results are obtained by providing very wide streets. Aside from the attractive appearance of broad avenues, traffic is greatly facilitated by leaving room on each side for a large number of vehicles. A further advantage of the very wide boulevard is the fact that narrow parks or plots of grass may be established as the dividing line. Riverside Drive, New York City, is sufficiently wide to carry three thoroughfares divided by handsome trees. In the case of entirely new boulevards grass plots with shrubs and flowers can be obtained in a single season. Birmingham, Ala., has introduced a novel feature on Highland avenue by transforming the roadbed of a street railway into a grass plot.

From tasteful grouping of shrubs and trees some towns have given careful thought to harmony of color in the planting of flowers. Just what will happen when the futurist movement demands vivid and contrasting colors remains to be seen, but as we are governed largely by prevailing fashions, something gorgeous may be anticipated. However, the fact that every ornamental accessory increases cost of maintenance will have a tendency to preserve the more simple types of boulevards. Where fine old trees arch over the thoroughfare nothing better is required. Such streets are certainly more attractive than the over-ornate. Straining after unusual effects invites disaster. Frederick Law Olmstead's story of the transformation of a simple and charming old New England common into an "Italian garden" by a too ambitious village improvement association illustrates the point. Philadelphia had an esthetic brain-storm some years ago, and the debris is still there in the shape of bare and forlorn frame pergolas along dusty, sun-baked sidewalks. Many small towns having tree-shaded streets could transform them into beautiful avenues at little expense, a profitable thing to do in every sense of the word.

To obtain satisfactory results, modern requirements prescribe that boulevards shall combine utility with beauty. The two cannot be divorced. For example, many old towns have

beautiful streets, but streets entirely lacking from the standpoint of utility, economy and convenience. Few things are more picturesque than an old town or village street shaded by ancient trees. The very absence of curbs, the irregular grass-grown gutter embankments and winding pathways for pedestrians, emphasize their charm, just as the rudely cobbled and narrow streets of European towns appeal to us as beautiful and picturesque. But the price paid for beauty of this kind—the sacrifice of utility and sanitary requirements—is too great. Therefore the modern boulevard or street beautiful must be well paved, and at the same time in harmony with its environment. It must be free from mud and dust, possess minimum tractive resistance and have a surface sufficiently resilient to deaden noise and meet the requirements of both horse and motor traffic.

Perfection from this viewpoint is easily obtained thru the use of asphalt pavements. All of the handsome boulevards pictured here were constructed with natural asphalt, which meets a further requirement—something that will not show replacements in case it is necessary to take up or repair a section of street. The patched-looking street is always unsightly and objectionable.

The beautiful street is not a luxury, but absolutely essential to the successful development of the city beautiful.

Winter Operation of Water Works

at Miles City, Montana

By G. C. Pruett, City Engineer.

An interesting paper on the troubles found in the operation of a water plant, particularly as to meters and pipe lines, in a more than ordinarily severe winter in a cold climate, which contains many practical points for all water works superintendents.

MONTANA has just emerged from the severest winter of which there is any record in this part of the state. The extreme cold of 48 degrees below zero had never been reached but once since the establishment of a weather office in Miles City some thirty years ago, and the long continued extreme cold 45 consecutive days below zero as a minimum temperature had never been reached before. The cold weather started about the middle of December when we had considerable snow, with the temperature around zero, from then until the first of January. January and half of February were continuously below zero with a slight break from the 15th to the 25th of February, then more zero days to the 5th of March. All told we had 60 days below zero minimum temperature during the winter, most of which were from 15 degrees to 30 degrees below. During this time we had a great deal of snow, often snowing when the thermometer stood at 20 degrees below zero, which is very unusual for this section, where it seldom snows after the thermometer reaches zero.

We began having meter trouble on the 11th and 12th of January, when the thermometer reached 46 degrees below zero on the 11th and followed up on the 12th with 48 below. On those two days we removed 30 meters from basements frozen out of a total of 950 in service. These meters were all left out until the cold weather let up, replacing them with pieces of pipe cut to the exact length of the meter and connected between the meter connections. From the 12th of January to March 1st we removed 25 others, making a total of 55 meters removed on account of freeze ups, and 15 from other premises where there was danger of freezing. Fifty of these were replaced in three days by two men after the 1st of March. The balance being underground installations, were not installed until between March 25 and April 1, being replaced at the rate of five per day by the same two men.

The damage done to the meters was comparatively small; only one meter was completely ruined, six had their intermediate gears spoiled, eight had stems connecting from intermediate to register gears twisted off. The balance merely had the frost bottoms hursted or flanges sprung, all of which were easily repaired at a nominal expense. The total cost for labor, material and testing (all were tested before being replaced) amounted to a trifle less than $150, or, based on the total meters in service, 15.8 cents per meter.

Our service trouble started about February 1, and reached a maximum about February 15, gradually decreasing until March 10, since which time we have had no further trouble. All told we had 130 services frozen outside of basements during the winter, but inasmuch as several of these were frozen two or three times during that period, the actual number of services involved was a little less than 100, or approximately 10 per cent. of the total in use.

The principal places of trouble we found to be at the gooseneck and at the curb box, with several frozen at the gutter line.

While the city does not assume the responsibility of thawing or taking care of the service pipes, it being the duty of the individual consumer to lay and maintain the service from the main, we found it necessary last winter to take charge of the thawing on account of the plumbers not having proper equipment for doing the work. The frost was so deep and so hard that an attempt to expose the pipe by digging down to it meant considerable delay in re-establishing service. For that reason the city purchased the necessary equipment, which consisted of one 1,100 to 50-volt transformer, cable, meter, switches, choke coil, etc., and constructed an electric thawing apparatus. The whole equipment was placed on a trailer and pulled by a Ford roadster. In thawing, connection was made to the electric mains, the current stepped down to 50 volts and connections made to the house water system and the nearest fire hydrant. The amount of current was controlled by the choke coil and checked by an ammeter in the thawing circuit. For ¾-inch services the current was not allowed to exceed 150 amp., and at this rate a service which had not been frozen more than a day was thawed in about 20 or 30 minutes, altho we had some cases requiring one to three hours. With that amount of current it was also not possible to thaw frozen goosenecks. These were thawed by digging them up or by using a portable steam rig as described later.

The reason for limiting the current to 150 amp. was because by trial this was found to be the maximum which could be successfully used without danger of causing the pipe or gooseneck to burst. Heavier currents melted the wiping between the lead and brass or heated the pipe so quickly as to cause it to break. After a little experimenting we only broke one connection in about 100 thawed.

The charge made for thawing was $5.00 per hour or connection and $5.00 for each hour after the first, i. e., minimum charge was $5.00. This only covered the rent of the rig and three men to handle it, employes of the light department. In addition to this, the consumer was required to have a plumber to take care of any pipe work and look after leaks in case any should develop.

We also had some trouble with hydrants and mains. The first main froze on February 20, it being a long dead end with few consumers. The point where it froze was at a bend where a run-off had been graded in the street and the pipe left with about 4½-foot cover.

The freeze was limited to a section about 100 feet long and was thawed with a portable 8-h.p. steamer mounted on a sled. Holes were first driven down to the pipe about 20 feet apart, by means of 1-inch drills pounded down with a sledgehammer. Steam was shot into these holes until the frost was drawn and then the pipe was uncovered at these holes in sections of about 5 feet. Short pieces of pipe were then worked along the top of the water pipe and thoroly steamed from one hole to the next. The main was tapped to locate the frozen section and the steaming process continued from hole to hole until the main was opened. It did not break and gave no further trouble from freezing, altho the frost was below the main before it was steamed.

About the time this first section was opened two other sections froze the same day. One of these was also a dead end and the other a connected circuit where the street had been graded down until there was little more than a 4-foot cover on the pipe. This latter was a considerable stretch—about 400 feet. The first of these was thawed as described above. It was sufficiently deep, i. e., compared with other sections of town where we had no trouble, but the soil was a gravelly sand,

very porous, down from about 12 inches of the top. The top 12 inches was light loam. This material was not frozen hard—in fact, it could be spaded without picking after the first 2 feet—but handfuls of it around the pipe showed frost crystals. One joint of pipe was split.

The other freeze-up of these two was uncovered the whole distance. First, the section was valved off so as not to interfere with the service in the balance of the district, then the frost was drawn by means of steaming holes drilled 10 feet apart, as described above. Five split joints were found in this section, and, after being replaced, the whole pipe was lowered 18 inches. Only two joints in the 400 feet showed leakage from the lowering and they were only seepage leaks.

The cost for this work was as follows:

Labor—	
Steaming	$ 40.00
Cutting in two valves	18.50
Repairing main	13.00
Lowering main, uncovering and back-fill	120.00
Total labor	$191.50
Material	52.00
Total	$243.50

Labor, $3 per day for eight hours; foreman, $4.00 per day; team without driver, $3.00 per day. No rent charged for steamer or tools.

The only other place where we had trouble was on a street where the pipe had a 5½-foot cover and mostly loamy soil, which would not be expected to freeze so deep, but on account of the poor surface drainage we found good 6 feet of frost. This was the deepest frost found. We had no difficulty in steaming it out, and after replacing one split pipe in a run of 120 feet we had no further trouble.

The total cost of taking care of our 20 miles of mains on account of freezing was $650, or $32.50 per mile.

The fire hydrants presented a new problem to my experience. Heretofore our trouble has been limited to water freezing in the barrels, due to leaky valves and poor drainage. While we have not had a great deal of trouble in the past, what we did have could be traced to one of these causes.

Last winter we not only had these troubles to contend with, but also trouble with the connections freezing adjacent to the valves. During the winter we found only two hydrants frozen in the barrels and twenty frozen just outside of the valve, out of a total of 150. Some of these twenty froze more than once after being thawed.

The thawing was done with the portable steamer by hooking directly onto the nozzle with a cap tapped and connected with the steam hose. The hydrant was left closed to blow the steam, which was carried at 50 pounds for this work, out thru the drain opening. This not only warmed up the hydrant and pipe, but the ground around the hydrant also. It took about ten minutes per hydrant on an average. As soon as this trouble developed we went over all of them each week and steamed them whether they were frozen or not.

The cost for three general steamings and the special attention given to the bad ones cost $120 at the wages stated above, but not including boiler rent, or an average of 80 cents per hydrant.

It has been our practice to crate the bad hydrants each winter and pack them with dry straw manure. We have probably averaged crating fifteen each winter, but last winter this apparently did no good; besides, it froze so solid one needed a pick to get to the hydrant.

The frost last winter averaged about 2 feet deeper than we have had it before, probably accounted for by reason of the heavy soaking rains thruout the fall and early part of the winter. The ground went into the winter with more moisture than I have seen before, and notwithstanding the heavy covering of snow, the frost went down very easily. I am of the opinion that if the ground had been ordinarily dry when the snow fell we would not have had an unusual depth of frost.

ILLINOIS RUSHES HIGHWAY WORK

By S. E. Bradt, Secretary State Highway Department, State of Illinois.

That Illinois is determined to make up for lost time in the matter of highway improvement is apparent from the rapid development of public sentiment since the passage of the Tice law.

Ninety-two of the 102 counties accepted and used the 1913 and 1914 state allotments; 100 counties accepted the 1915 allotment.

There was expended under the direction of the state highway department to January 1, 1916, the following:

Appropriated by legislature in 1913 from general fund	$ 300,000
Appropriated by legislature in 1913 from auto license fees	800,000
Appropriated by counties	1,100,000
Total	$2,200,000

With the above there have been constructed approximately 150 miles of state aid roads, mostly concrete and brick, in seventy-two counties, and 811 concrete bridges and culverts in twenty-five counties.

There will be expended by June 30, 1917, in addition, the following:

Appropriated by legislature in 1915 from auto license fees	$2,000,000
Appropriated by counties	2,000,000
Total	$4,000,000

This, with the 1913 appropriations above referred to, makes a total of $6,200,000 to be expended from the regular state aid fund up to June 30, 1917.

It is estimated that there will be constructed by this department with the above fund from the beginning of work in July, 1914, to June 30, 1917, the following:

250 miles concrete at $12,000	$3,000,000
50 miles brick at $16,000	800,000
80 miles macadam or gravel at $6,000	480,000
Bridges	500,000
1,120 miles earth roads at $1,000	1,420,000
Maintenance	30,000
Total	$6,230,000

In addition to the above there will be expended during 1916 approximately $1,900,000 from county bond issues—$400,000 in Cook county and $1,500,000 in Vermilion county. Contracts in Vermilion county have been awarded. The above are portions of bonds voted in the two counties mentioned to the amount of $3,500,000.

MECHANICAL TAMPING

OF TRENCH BACKFILL

By C. W. Wilson, Superintendent Exchange Construction, Wisconsin Telephone Company, Milwaukee, Wis.

THE Wisconsin Telephone Company has never let any of its conduit work by contract, in view of the fact that we are not only very particular concerning the way in which our conduit is installed, but equally zealous in seeing to it that the work, at every stage, is not only properly done, but put thru in the quickest possible time.

In spite of the fact that we have developed a corps of experts on this class of work, we have substituted mechanical tampers for hand tamping, as our experience has proven that tamping machines, the same as concrete mixers, not only do the work more thoroly, but that it tends to speed up the entire job, as workmen are bound to quicken their pace in order to keep up with the machine.

Our experience has also proven that any soil which can be tamped by hand can be tamped by machine much more effectively and economically.

Tough Red Clay at Superior, Wis.

Our work at Superior, Wis., in connection with a large conduit installation, will form a basis on which we arrived at the foregoing conclusions.

On this job four miles of trench back-fill was tamped by hand and approximately 6,000 feet mechanically tamped. Bell tampers, 5 inches in diameter, were used by the workmen, while the head of the machine-tamping ram measured 9 by 12 inches. The average depth of trench was 3 feet, average width 18 inches. The material consisted of a red clay of exceedingly tough texture, which, when wet, was almost impossible to tamp by hand, but the tamper thoroly compacted it at an approximate saving of 6 cents per lineal foot over hand tamping.

The Board of Public Works of Superior, Wis., first insisted that we remove all the excavated material and refill the trench with sand. When we demonstrated to them the efficiency of the tamper, they allowed us to back-fill with the clay, thereby saving more than the price of the machine, including freight, in sand alone. The sand would have cost 80 cents per yard delivered on the job, with an additional cost of 75 cents per yard for removing the excavated material—total cost of $1.55 per yard.

Costs of Both Hand and Machine Methods.

The machine referred to is a Pawling & Harnischfeger power traction tamper, equipped with a 3-h.p. 4-cycle engine. On this job accurate cost records were kept, so as to determine the actual dollars and cents difference between the two methods. The conditions under which the hand tampers competed with the machine were identical.

On Ogden avenue, between Twenty-first and Twenty-second streets, a distance of 464 feet, the actual cost of tamping was $9.13, or 1.9 cents per linear foot, with the power tamper. Another section on Ogden avenue, between Nineteenth and Twentieth streets, a distance of 417 feet, cost $5.06, or 1.2 cents per linear foot, with the power tamper.

In the alley north of Belknap street, between Banks and Tower avenue, a distance of 322 feet, the trench was tamped by hand entirely, at a cost of $23.80, or 7.3 cents per foot. In the same alley, between Banks and Oaks avenues, a distance of 345 feet, the cost of tamping by hand was $25.53, or 7.4 cents per linear foot.

In the alley north of Banks, between Hewitt and John and

P. & H. POWER TRACTION TAMPER, AS OPERATED BY THE WISCONSIN TELEPHONE COMPANY. ON SYCAMORE STREET, MILWAUKEE. THIS MACHINE KEEPS 6 TO 8 SHOVELLERS BUSY AND DOES THE WORK OF EIGHTEEN HAND TAMPERS.

SHOWING MACHINE TAMPING SURFACE FILL. NOTE COMPACTING EFFECT OF TAMPER HEAD.

Fourteenth and Fifteenth streets, a distance of 358 feet, a trench was back-filled and tamped partly by machine and partly by hand, at a cost of $19.85, or 5.5 cents per linear foot.

On Ogden avenue, between Fifteenth and Sixteenth streets, a distance of 466 feet, tamping by machine cost $16.90, or 3.6 cents per linear foot. This high cost was due to the fact that the excavated material had been rained on and made it more difficult to shovel.

On Ogden avenue, between Eighteenth and Nineteenth streets, length of trench 427 feet, back-filling and machine tamping cost $8.88, or 2 cents per linear foot.

On Cummings avenue, between Harrison and Seventeenth streets, a distance of 320 feet, back-filling and hand tamping cost $24.80, or approximately 7.5 cents per linear foot.

On Cummings avenue, between Seventeenth and Eighteenth streets, a distance of 320 feet, hand tamping cost $29.80, or 9.3 cents per linear foot.

Method of Filling and Tamping.

In back-filling trenches for telephone conduit, the method used by water, gas and sewer contractors cannot be used; in other words, the dirt must be put back dry, owing to the fact that the trenches cannot be flushed or puddled, for the reason that they are filled immediately after the concrete has been placed on top and bottom of the conduit, and any flushing of the trench would tend to wash the cement out of the concrete and make it worthless.

Our method of refilling the trenches, in connection with the use of the power tamper, is to place a layer of loose dirt about 8 inches deep on the top of the concrete before it has had its initial set. The power tamper, in passing over this, will compact it to about 4 inches in thickness.

Immediately behind the tamper follow six to eight shovelers, putting in another layer of loose dirt of about 8 to 10 inches in thickness. When the tamper has reached the end of the trench it is reversed and travels right back over the same ground and the shovelers pass to the other side of the tamper and follow until the trench is completely filled, including the replacing of the surface material, such as crushed stone or gravel, as the case may be, on macadam or dirt pavements. On streets with a concrete foundation, this filling process is followed to the base of the concrete foundation, after which the concrete is placed to complete the foundation for the pavement.

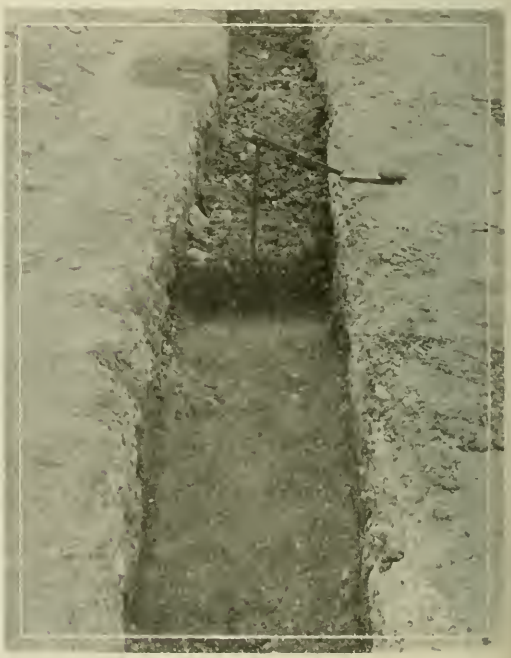
Machine Operation.

The machine, while tamping, travels at the rate of approximately 9 feet per minute, or 540 feet per hour. Our experience as developed with the machine is that it keeps six to eight shovelers busy, depending on the nature of the soil, and there is considerable satisfaction in knowing that after the machine has gone over the trench it is properly and thoroly compacted.

In order to accomplish the same result by hand as obtained by machine, it would be necessary to use eighteen tampers with the six shovelers, at a cost of 25 cents per hour, or a total cost of $8 per hour; whereas with the machine the cost for labor, not figuring the cost of the operator, $1.50 per hour, effects a saving of $6.50 per hour.

We are now using the machine on an installation of 3,600 feet of conduit on Sycamore street, Milwaukee, and at the same time we have two other crews in other parts of the city, the foremen of which are both clamoring for a machine on their jobs. We have, therefore, just placed an order for two more machines. We have used this machine very successfully in cutting asphalt and breaking concrete. In order to do this the machine must be equipped with a special ram, also fur-

SHOWING STRIP TAMPED BY MACHINE TRAVELLING AT RATE OF 9 FEET PER MINUTE.

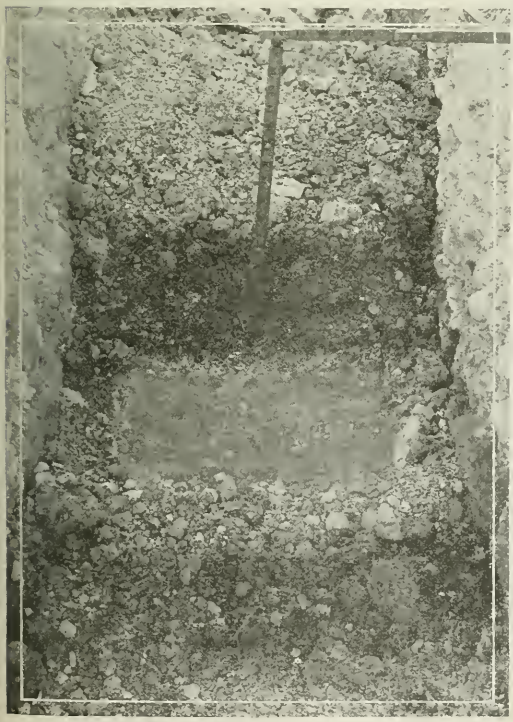


nished by the manufacturer, which takes a spud for breaking concrete or a knife for cutting asphalt.

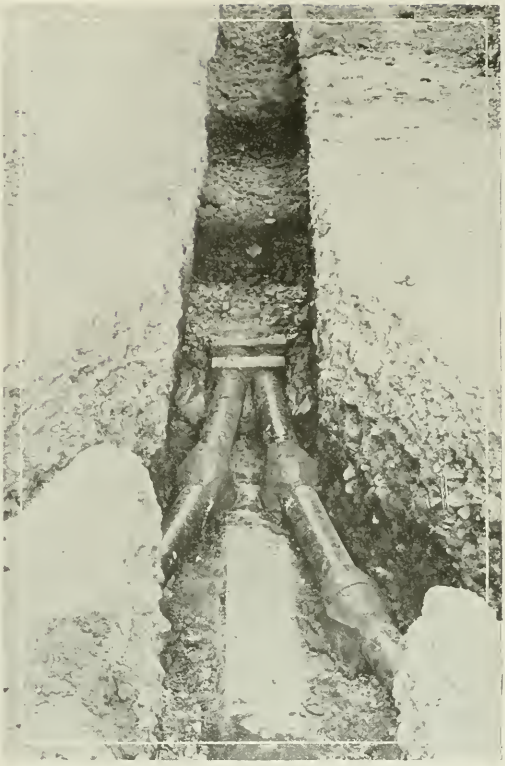
We found that the best method to follow in cutting asphalt was to mark out the square to be removed with blue crayon, and then to move the machine down one side of the trench, following the chalk line, and reverse same and come back on the other side. We were able to cut entirely thru the asphalt to the concrete base about 60 linear feet per hour, both sides of trench.

Tamping Ram and Head.

The 150-pound ram drops approximately 26 inches about 42 times every minute, and the machine travels forward at a definite rate, so that a perfectly solid, uniform base is formed, which will support the pavement. This ram on its carriage is supported by two 6-inch rollers and moves across the machine on a steel runway. The standard tamping head is 9 by 12 inches, and has a maximum cross-travel of 16 inches, thus enabling it to actually cover 27 inches of trench. The tamping head is fastened into the bar of the ram by means of heavy bolts placed thru the lugs on the head, and is operated by means of a segmental pulley, brought in friction contact with the hardwood ram, by spring pressure on a large pulley on the opposite side of the ram. This segment is caused to revolve approximately 42 times per minute, causing a stroke of the ram at each revolution. This stroke has an average of 26 inches travel, and, as the ram and tamping head together weigh 150 pounds, a thoro packing of the earth results. A good laborer, with a 15-pound ram, will not average more than



SHOWING EFFECT OF ONE BLOW OF TAMPING HEAD ON BLUE CLAY BACK-FILL.



SHOWING CONDUIT JOINT PROTECTION, CONCRETE MASS AND TWO LAYERS OF BACK-FILL MECHANICALLY TAMPED.

20 strokes a minute, and with a heavier ram the number is even less. The laborer will hardly ever lift the ram more than 9 or 10 inches. Compare this with the machine's 150-pound ram, 26-inch stroke, 42 times per minute, and "do it all the time.

Human muscle, or man-power, is not always applied to a hand tamp. Even in the case of the conscientious workman the limit of endurance is soon reached and the hand tamp is merely raised to be permitted to drop of its own weight. As such feeble blows lack the necessary punch, the surface of the back-fill is merely smoothed over; it is not thoroly compacted or tamped.

While the tremendous savings in labor costs are no mean item, the assurance of work well and properly done should not be overlooked. Mechanical tamping also effects a great saving in worry and accounting.

The speedy completion of every job is also greatly appreciated by the taxpayers and the municipality, as the streets are again soon opened to traffic.

From our standpoint there is also the assurance that we will be minus complaints caused by the settling of pavements.

As each machine takes the place of eighteen hand tampers, we have just that many less men to strike, take sick, loaf on the job or lay off. There are no stalling or wasteful delays caused by hand tampers waiting for the shovelers to catch up. There is no watchful waiting, as the power traction tamper speeds up the work; shovelers (no time to light pipes) work continuously in order to keep up with the tamping machine.

MUNICIPAL ASPHALT PLANT

OF MANHATTAN BORO, NEW YORK CITY.

THE municipal asphalt plant of Manhattan boro, New York City, will complete its second year of operation on May 25, and has demonstrated its value beyond question. The construction of a plant has been advocated for some fifteen years, but it was not until 1912 that authority to build and operate it could be obtained, based on a detailed report by E. P. Goodrich, then consulting engineer of the boro, to the boro president. The plant was begun in March, 1913, and completed and put into operation on May 25, 1914.

The plant is located in the East river, between 90th and 91st streets, and running back to Avenue A, with dock facilities for unloading material. This location is so central that the maximum haul to any point in the boro is but $7\frac{1}{2}$ miles.

VIEW SHOWS 120 CUBIC FOOT TRAILER BENEATH MIXER. ILLUSTRATING METHO OF JACKING UP FROM EXTRA SET OF WHEELS SO THAT TRACTOR CAN BE PLACED UNDERNEATH.

A Meade-Morrison hoist with 40-foot grab-bucket lifts material from barges and discharges it into a steel-lined hopper on a tower over three tracks running to sand, stone, and coal storage buildings. The hopper discharges into dump cars on these tracks, which run over the trestles to the respective buildings and dump into them thru openings in the roof. Spiral conveyors carry sand and stone from storage to bucket elevators, which dump directly into any one of these dryers.

The rotary dryers are 24 feet long by $5\frac{1}{2}$ feet in diameter, may be operated independently and are used two for sand and one for stone. Capacity of each is 15 tons of sand per hour from 50 degrees to 400 degrees F. The forced draft operates opposite to the flow of the materials thru the drums and the temperature of the outflowing sand or stone can be regulated exactly by watching pyrometers placed where the fireman for the three furnaces can see them. The heated material is carried by bucket elevators to the top of the building to a 660-cubic-foot capacity sand bin and a 450-cubic-foot stone bin, the sand passing thru a 10-mesh screen on the way. The rejected sand is conveyed to the bottom of the stone elevator for use in the binder. Weighing boxes at the outlets of the bins discharge the exact amounts required for the mixtures. The limestone dust bin is filled by cars elevated on the platform elevator noted below. A spiral conveyor under the bin discharges the dust tdirectly into the weighing boxes.

There are four 40-ton asphalt melting kettles, each heated by 250 square feet of $1\frac{1}{4}$-inch diameter steam pipes. Each kettle is fitted with pipes for agitation of the melted asphalt by air or by dry steam at the 110-pound pressure necessary to heat it to 310 degrees. The asphaltic cement is chopped in pieces as it comes from the barrels and put in small hand cars, which are raised to the kettles on a platform elevator and emptied into the kettles as required. The fluxing oil tank of 25,000 gallons capacity is filled by a pipe, 150 feet long, running to the water front, where it can be pumped from the delivery tanks. Coils in the bottom of the tank heat the oil, which is automatically pumped to a weighing tank on movable track running on top of the asphalt kettle. The asphaltic cement is piped from the melting kettles in steam jacketed pipes to the weighting 2buckets hung on a trolley from which they can be emptied into either mixer.

There are two Iroquois 16-cubic-foot mixers with tips bolted to the blades so that the tips only need to be removed for renewals. The mixers are jacketed with 40-pound steam.

Two 150-h.p. boilers and a 150-h.p. Corliss engine operate the plant with air compressor for agitating asphalt kettles, pump for elevating flux oil to weighing bucket and several pieces of apparatus for the machine shop adjacent.

Gases and dust from the dryers flow thru a horizontal steel flue to a dust washing chamber supplied with water in sheets thru which the gases pass and lose nearly all their dust.

The garage has, besides the department autos, six Saurer tractors, 37-h.p., 4-cylinder 4-cycle, with fifteen trailers, each 120-cubic-foot capacity, to haul material to the street. The trailers can be detached at plant or on the street and set on an extra set of wheels, so as to be hauled by the street roller.

The street equipment includes enough for twelve street gangs, including five Good Roads Machinery Co., and seven Kelly-Springfield asphalt steam road rollers for rolling asphalt

VIEW SHOWING FIVE-TON ROAD ROLLER HAULING 120-CUBIC-FOOT TRAILER FROM PATCH TO PATCH ON ASPHALT REPAIR WORK.

and hauling 8-ton trailers around on the street; and for each gang, 5-ton steam roller, tool wagon, canvas cover for tools and full complement of nineteen kinds of tools, barricades, signs, lanterns, etc.

The capacity of the plant was stated to be 3,000 square yards of pavement in eight hours. On one day in July, with only two of the three drums in use, 4,500 cubic feet were turned out in eight hours, eleven gangs laying 2,600 square yards of pavement. The 4,500 cubic feet would lay 2,000 square yards of 3-inch asphalt, or 3,000 square yards of 2-inch asphalt.

In the main office of the Bureau of Highways is a map upon which is recorded the condition of each and every street in Manhattan boro. This information is shown by different symbols and is taken from reports furnished by the district inspectors, who make periodic reports regarding the amount of wear and tear and openings in the streets.

The superintendent and gang supervisors get their information from this map and thus lay out the work for the street foremen.

In order to make possible the delivery of material on time, five gangs start work at 7:00 a. m., five gangs at 8:30 a. m., and two at 9:00 a. m. In this way, the tractors get a load to the 7:00 a. m. gangs before 8:00 a. m. and are back to have a load to the 8:30 a. m. gangs before 9:30 a. m.

In company with the gang supervisor where possible, the foreman marks out the patches to be cut out and repaired. For the first hour, the whole gang goes cutting out, the dirt truck is on hand and the old asphalt is shoveled into it and taken to a department of street cleaning dump. There is enough cut out for nearly half a day when the hot material arrives. Two men shovel material out of the trailer, then two small gangs of one raker, one tamper, one smoother and two wheelbarrow men start placing material in the patches.

The roller engineer reports one hour later than the rest of the gang and is ready to roll the patches when placed. When the days' work is done, the patches are accurately measured and located by the foreman. This is sent to the plant office with the time record of his men. The roller engineer is the last man off the work and sees that everything is in shape.

When on burner work the organization is different. With the ordinary surface heaters, there being no cutting to do, these men handle the burners; one man to each. This man also rakes the material away. From one to five burners are used at a time. Usually burner work has been from curb to curb, three to five burners being used.

LAYING TOPPING BEHIND LUTZ SURFACE HEATERS, 1,200 SQUARE YARDS LAID IN AN EIGHT-HOUR DAY.

On West End avenue, from 72nd to 74th street, the Lutz surface heaters were used and easily burned over 1,000 square yards in eight hours. These blocks were resurfaced in first-class shape at the rate of one a day.

The summaries of cost show an average cost per yard for the season of 90 cents. There was a progressive reduction in cost each month, from $1.02 in March to 78 cents in July. For the month of June, during which cost per square yard averaged square yard for plant operations, including material for mixtures, direct labor and overhead, varied from 33.54 cents for work done for the department of water supply, gas and electricity, to 37.67 cents for repair of cave-ins, both very small 80.62 cents, details are given in full, and the average cost per percentages of the whole work done. Straight cutting and replacing with asphalt comprised 48.5 per cent. of the whole work done and plant operations cost 35.995 cents per square yard. Burner work comprised 39 per cent. of the work and plant operations cost 36.01 cents per square yard. Street operations cost 44.66 cents per square yard for straight cutting and burner work cost 44.657 cents. The total cost of straight cutting was therefore 80.655 cents per square yard, and of burner work, 80.667 cents.

The yardage of the month, 39,560 square yards, includes 1,509.6 square yards of stone foundations relaid, and as this work averaged 80.94 cents a square yard, it affected the total average very little.

Of the 6,500,000 square yards of sheet and block asphalt in the boro about 3,000,000 square yards of sheet asphalt and 1,000,000 square yards of asphalt blocks are kept in repair by the municipal plant. In this work 283,144.8 square yards of asphalt were laid at a cost estimated at $1 a square yard, when depreciation, interest, etc., are added to the 90 cents above, which latter includes other overhead charges.

The motor equipment is reported to show a saving of at least $60.00 a day over horse-drawn vehicles. It would take twenty-four horse-drawn wagons, at $7.00, to supply twelve gangs, or $168.00 a day, as against six tractors, at $18.00, or $108.00, this figure including repairs, interest, depreciation, etc., and may be even less when accurate figures are obtained.

USING TWO LUTZ SURFACE HEATERS ON WEST END AVENUE TO DETERMINE THEIR ADVANTAGE OVER SMALL HAND BURNERS.

WORKERS IN THE FIELD

Street Paving in Champaign, Illinois

The Editor of MUNICIPAL ENGINEERING:

Sir—Many improvements have taken place in paving construction as well as in the machinery and methods in use thirty years ago. One of the first improvements that came was the use of the roller, which I had cut out of solid stone by a mason, and used to roll the subgrade. At about the same time I secured an 1,800-pound iron hand roller for rolling the brick. This was a big improvement over hand tamping, and

A FLEET OF BAKER-MANEY SCRAPERS

was in general use until the horse roller made its appearance. Slip scrapers next gave way to two-wheel scrapers which made a big saving over loading dirt by hand.

We used to mix concrete by hand on wood boards. We considered we had made a big improvement when we adopted sheet steel mixing pans. The first power mixer was brought in about 1905, and while it was too large, at first, for use in narrow streets and was looked upon as a freak, it soon replaced human muscle methods.

About five years ago gravity carriers came in and we now run the brick from cars to wagons and from the wagons to the setters.

USING A GRAVITY BRICK CARRIER.

At present our rough grading is done with Maney four-wheeled scrapers which are loaded with tractor engine. The rolling of subgrade is done with a 10-ton steam roller and the concrete is mixed with a batch mixer which delivers it thru a chute to the spot wanted in the street.

Nearly all streets laid in Champaign in the last few years have combined concrete curb and gutter laid in 7-foot sections and hand finished. On the concrete base is placed 1½ inches of sand cushion, which is struck off with a Roughen adjustable paving gage running on the gutters. On this are laid the regular paving block and, after the culls have been removed, they are thoroly rolled, inspected again and any broken brick removed. The street is then rolled the last time and the filler is then placed.

Altho brick pavements are built better all the time, there has been very little increase in the price per yard to the city in thirty years, in spite of the fact that the cost of labor has nearly doubled in that time. This has been made possible only by the contractor using the most advanced improvements in equipment and constantly watching his work for a chance to improve.

It seems, unfortunately, to be the rule for the city to ap-

MIXING THE FOUNDATION.

PROUD OF THEIR WORK.

point as an inspector some man to whom the city fathers want to give a job without any special regard to his qualifications for the work, so that the inspector instead of being one whom the contractors can look to for help in getting the best possible job, often hinders the contractor, for altho his intentions are good, he simply does not know proper construction.

Thirty years ago all our work in Champaign was paid for by vouchers in five years' time. The city issued five separate vouchers against each piece of property assessed, one of which was due each year for five years with interest. It can be seen that in paying in this way on an improvement of any size, the contractor received about a ton of paper.

Now the city issues special assessment bonds due in from one to ten years, bearing 5 per cent. interest, which makes it very much easier to handle.

J. W. Stipes, Contractor,
Champaign, Ill.

Contract for Current for Street Lighting Criticized

The Editor of Municipal Engineering:

Sir—I see by the *Electrical World* that the Ft. Wayne and Northern Indiana Traction Company has made a proposition to the city of Ft. Wayne, for furnishing electrical energy for the operation of the city's street lights. The city of Ft. Wayne does not furnish electrical energy for light and power purposes other than street lighting, as I understand it.

This, of course, is a mistake, because the city can do its best only when it furnishes electrical energy for all purposes. The same organization, the same poles, will carry the equipment for both purposes and naturally cut down the overhead expense and increase the efficiency of the system. This is the thing the city ought to do rather than lease its system or turn it over to the power company. The power company, of course, is afraid that the city will ultimately do this and they are consequently making them a seemingly low rate for their street lighting. They can, of course, make them a low rate for street lighting, sacrifice on street lighting and take it out of the private consumer. This is exactly what they are going to do if they are successful in this proposition. Somebody ought to protest and protest so loudly that the whole community can be educated on this matter and taught to see their interests in this whole proposition. Otherwise, this proposition may go thru and the city for ten years will have a contract on its hands which will rob them of the real success of municipal ownership of this electric utility.

Superintendent of Municipal Lighting Plant.

Commission on Building Districts Submits Tentative Report to Board of Estimate of Greater New York

The commission on building districts and restrictions has transmitted to the board of estimate a tentative report presenting plans for the districting of the five boros of New York City. The plans provide for residential, business and industrial districts and for the limitation of the height of buildings and the area of the lot that may be covered. The commission will now hold a series of public hearings on the tentative report and plans and later submit a final report, which, if approved by the board of estimate, will definitely establish the proposed plan.

This will constitute the most important step yet taken by any American city toward the direction of the building of the city in accord with a well-considered plan. It will stop haphazard, heterogeneous development and substitute a commonsense plan of building control.

The commission has taken up the work begun by the heights of buildings commission appointed by the board of estimate in 1913. Following the report of that commission in 1914, the necessary legislation was promptly secured and the present commission appointed by the board of estimate to work out and recommend a comprehensive districting plan. Edward M. Bassett, formerly chairman of the heights of buildings commission, is now chairman of the districting commission. Its membership contains leading representatives of the real estate, lending and civic interests of the city. Walter Stabler, comptroller of the Metropolitan Life Insurance Company, has been very active in the commission's work, serving as chairman of the Manhattan sub-committee. The commission's secretary, Robert H. Whitten, and consultant, George B. Ford, have had charge of the expert work in the elaboration of the tentative plans. Herbert S. Swan has served as investigator, John P. Fox as transit expert and George W. Tuttle and Edward M. Law as engineers.

The commission says that "the bigger a city grows, the more essential a plan becomes. Traffic problems, the congestion of population, the necessity for an intensive use of land, the magnitude of property values affected, make the control of building development more and more essential to the health, comfort and welfare of the city and its inhabitants. New York City has certainly reached a point beyond which continued unplanned city growth cannot take place without courting social and economic disaster. Thru haphazard construction and invasion by inappropriate uses, the capital values of large areas have been greatly impaired. This destruction of capital value not only in the central commercial and industrial center of Manhattan, but also thruout the residential sections of the five boros, has reached huge proportions. It does not stop with the owners in the areas immediately affected, but is reflected in depressed values thruout the city. Market value for investment purposes is always affected by the hazard of the business. Whatever the capitalized amount that may properly be charged to the economic depreciation hazard, it is certainly a huge burden and one that affects not only the individual owners of real estate thruout the city, but the savings and other large lending institutions, the municipal finances and the general welfare and prosperity of the whole city. Permanence and stability can only be secured by a far-sighted building plan that will harmonize the private interests of owners and the health, safety and convenience of the public."

The merchants themselves are taking a first step toward districting the city, having devised a plan whereby, thru their own concerted action, they can move out and keep out of the finest shopping hotel and theater district of Manhattan boro, the manufacturers who have begun to establish themselves in the various buildings in that district which can be adapted to their uses.

The New York City Bond Sale

The successful sale of $55,000,000 4¼ per cent. bonds by the city of New York last month on an average of 4.10 per cent. is the strongest kind of evidence of the growing popularity of the income-tax exempt municipal bond.

In spite of the crisis in our foreign relations that was reached practically a few minutes prior to the public sale of the bonds, a number of powerful banking syndicates and dozens of the city's most prominent investment concerns, submitted flattering offers for the issue, oversubscribing the amount for sale about three and a half times.

The New York City sale is a reliable indication of the ease of the American money market and its results this time show very plainly, first, that there is a vast amount of capital seeking investment; and second, that the municipal bond, yielding less than 4¼ percent., but free from present and future federal income taxation, is coming to be the careful investor's favorite investment security.—*The Daily Bond Buyer of New York.*

FIRE DEPARTMENT

Chief Hugo R. Delfs, Fire Department, City of Lansing, Mich.

Did Lansing Buy First Pumper?

Chief Hugo R. Delfs, fire department, city of Lansing, Mich., reports but three horses in active service; two being used on an antiquated hook and ladder truck, while the other "continues to eat" except when called out by the fire alarm telegraph department, all of which is but an emphatic way of stating that the Lansing fire department is almost completely motorized.

We are illustrating Lansing's first motor pumper, which, in the language of Chief Delfs, is the first auto fire engine, built on order in America. It was delivered to us from the Webb Auto Fire Apparatus Company in the fore part of December, 1908, and placed in service December 16, 1908, and has been in continuous service ever since.

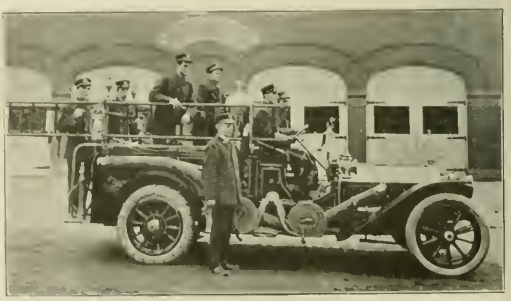
Has Lansing the Honor?

"Perhaps it would not come amiss to tell how we came by this auto fire engine. One certain spring, we had our usual election—taxpayers voting on a new high school, convention hall, two steam fire engines, etc. In fact, there was so much to vote on that the taxpayers went out and killed the whole business. A month or two after a newspaper clipping was sent to me by the late Judge Hooker, of the Supreme Court of Michigan. This clipping told of a remarkable automobile pumping engine, built by one A. C. Webb, a former auto racing driver. I became much interested and immediately got in correspondence with Mr. Webb. In a few weeks after that, Mr. Webb sent his demonstrating machine here to Lansing, and in less than three months he received an order for one of his auto pumping engines, the motor being supplied by the Olds Motor Works, of this city. The Webb demonstrator was rebuilt about the same time we ordered ours and sold to Joplin, Mo. It may be possible that Joplin had her engine in service a month or so before we had ours, but am not quite certain about this point.

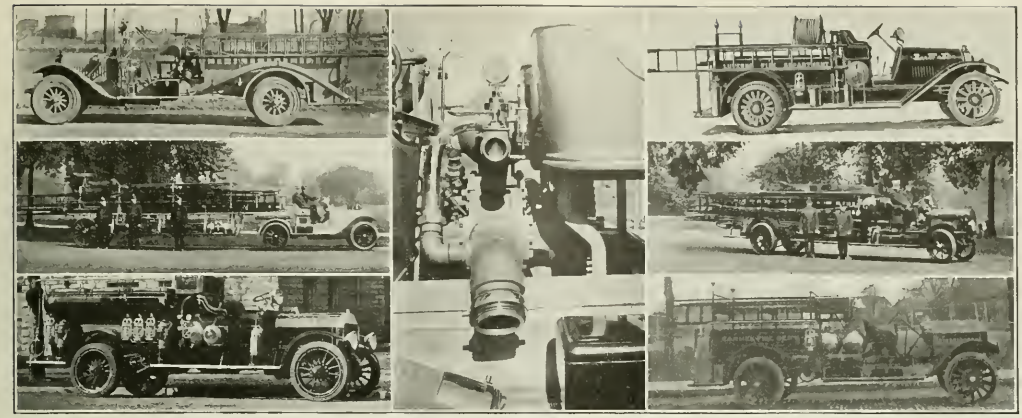
Cost of Seven Years' Maintenance.

"This engine has seen service in three different fire stations, and for your information, the following statement will give you an idea of the cost of maintenance, as compared with horse-drawn apparatus, covering a period of seven years, three months and twelve days to date, March 28, 1916:

"The total cost of maintenance for this period was $1,444.08. This was for gasoline, oil, spark plugs, minor repairs, repairs for two accidents (totaling $269.77), pneumatic tires (since equipped with Sewell cushion wheels) and solid tires, at a cost of $472.30. Every item of expense, including new equipment, we charged to the pumper and I assure you that every cent that was expended on this machine is included in the $1,444.08.



Webb pumper, Lansing, Mich., said to be first motor pumper built to order in the United States.



NEW DEVELOPMENTS IN MOTOR FIRE APPARATUS.

WHITE PUMPER COMBINATION, CITY OF NEW BEDFORD, MASS.

WHITE TRACTOR, CITY OF ORANGE, N. J.

INDIANA CONST., HOSE WAGON, CITY OF OTTAWA, ILL.

PUMP OF WHITE, NEW BEDFORD, MASS., COMBINATION. DELIVERED 800 GALLONS PER MINUTE FROM 11-FOOT LIFT IN DRAFTING SALT WATER. PINION GEAR CONNECTION BETWEEN ENGINE AND PUMP.

LUVERNE COMBINATION, CITY OF LUVERNE, MINN.

WHITE LADDER TRUCK, CITY OF ORANGE, N. J.

HOWE COMBINATION, CITY OF CARMEL, N. Y.

"Four horses would be required to do the same work—two on the engine and two on an accompanying hose wagon. Figuring the upkeep at $18 a month per horse or $864 a year for the four horses, brings the total, in seven years, three months and twelve days, to $6,292.80. At least two of these horses would have outlived their usefulness in the service, in this length of time, which would add $400 more. This you will find a fair comparison for I am charging new equipment to the auto engine. Add $50 a year more to the steam engine and hose wagon for fuel, oil, repairs, etc. This would give you a grand total of $7,056.86, less auto engine expense, $1,444.08, leaving a balance in favor of the auto engine of $5,612.78. You will find these figures absolutely correct and all auto apparatus in our department will average about the same in comparison.

"Since the buying of this small auto engine (capacity 550 gallons), we have purchased one other Webb auto pumping engine (capacity 700 gallons), also one Robinson Jumbo pumping engine (capacity 900 gallons). We have also added one straight double tank chemical engine and two combination hose and chemical cars. The chief's car was purchased in 1908, from the Olds Motor Works. This car has also been in service ever since. Detroit bought her chief the first chief's car in Michigan and soon thereafter Lansing purchased one. These two cars, as near as I can ascertain, were the fourth and fifth chief's cars in the country."

Standardizing Fire Equipment.

By motorizing the fire department and standardizing the equipment, the city of Orange, N. J., has reduced fire losses until it ranks first among the cities with the lowest per capita fire loss for the past year. The city has officially recorded its appreciation of the services of Fire Chief William H. Mathews, who has been unsparing in his efforts to bring about this efficiency.

It is believed by those who planned a model fire department for Orange that standardization of apparatus was essential. Just motorization would not guarantee everything in the way of improvements sought for.

"Quick response to all alarms by all the fire-fighting force—that is what we need to save property and lives. If one piece of apparatus arrives promptly, a second piece ten minutes later and a third a few minutes later, there is more or less confusion and valuable time is lost. But with all apparatus standardized, all arrives simultaneously and we go after the flames as one complete fire-fighting unit. Standardization is as important as motorization. We get to the fire quickly, we get there together and we get back quickly," says Chief Mathews.

The city of Orange, N. J., now owns one White 6-cylinder 60-h.p. truck, used as a tractor to motorize a horse-drawn hook and ladder; three White 4-cylinder combination chemical and hose trucks and one 4-cylinder 30-h.p. chief's roadster.

But Four Minutes Away.

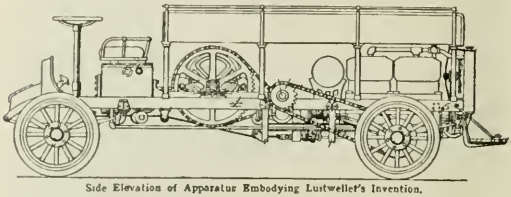
This equipment has brought the farthest alarm box within four minutes' run from the nearest fire station. The element of speed, always vital in a fire department, gave Orange concern when it began to consider motorization because of its hills. But the motor apparatus proved that the grades need not be considered when it demonstrated that hills, or no hills, the farthest fire box was but four minutes from the nearest fire station.

One of the possibilities of the new service was shown when Captain Thomas Hodgkinson took one of the combination trucks from headquarters to a fire 1½ miles distant in less than four minutes after the sounding of the alarm. In answering another alarm in the Orange Valley district, during a heavy snow storm, the truck averaged 18 miles an hour. This truck, in three years' service, never lost as much as a half minute, never failed to meet any emergency that confronted the fireman. All the equipment has passed the test of climbinb the roads up the Orange mountain.

Chief Mathews points out that the motors of the trucks are automatically started when an alarm is sounded. The self-starting switches are synchronized with the alarm system so that the engine starts when the gong rings. In winter all machines are equipped with warmers to keep heated the water in the radiators. This prevents delay due to chilled water and engine.

The first combination chemical and hose truck was installed November 4, 1912; answered 162 alarms the first year at an operating cost of $51.93, including tires. Compared with cost of horses, their feed, harness repairs, shoeing, veterinary bills

and other items when the equipment was drawn by horses, the motor equipment has shown a big saving in maintenance cost. Of course, in fire departments, this saving is but secondary to the great saving in property and lives.



Side Elevation of Apparatus Embodying Luitweiler's Invention.

Luitweiler Pumping Engine.

Letters patent have been issued to S. W. Luitweiler for an invention relating to that type of motor fire apparatus in which the motor is arranged to be used alternately for driving the vehicle and for driving a pump on the vehicle. The particular object of the invention is to construct and arrange the parts so as to secure great rigidity of the machine mechanism and to enable the parts to be assembled readily and securely; a further object of the invention consists in making provision for locking the clutch control between the engine and the pump when the latter is operating and to prevent the same being accidentally disconnected.

The inventor claims the following as new:

1. In a motor-propelled fire apparatus, the combination with an engine, of a drive shaft, a clutch for operatively connecting the engine and drive shaft, an operating member for the clutch, a lever, connections between the lever and the operating member, including an adjustable element which serves to connect and disconnect the lever with the operating member.

2. In a motor-propelled fire apparatus, the combination with an engine, of a drive shaft, a clutch for operatively connecting the engine and drive shaft, an operating member for the clutch, a lever controlling the operating member, and means movable with the lever and adapted to be moved independently of the lever for disconnecting it from the operating member.

New Type Combination Pumper.

The combining ladders, pump and hose in one piece of fire apparatus at New Bedford, Mass., is regarded as one of the most complete and efficient installations in the country. The ladders are one 35-foot extension, one 18-foot roof, one 12 and one 8-foot single ladder. The body carries 1,200 feet of fire hose. The pump is a rotary one with reducing plates for 800 gallons capacity. The fire-fighting equipment is mounted on a 6-cylinder, 60-h.p. White chassis.

No one is more enthusiastic over the success of this apparatus than New Bedford's chief engineer, C. F. Dahill. Mr. Dahill is regarded as an authority on fire extinguishing matters. He is the inventor of the Dahill rapid aerial hoist, the one-man simple hoist used generally thruout the country to raise the heavy fire ladders.

Asked about the combination apparatus, which is working under his direction, Chief Engineer Dahill said: "We like the machine very much. We have pumped over 800 gallons per minute from a plug and 727 gallons per minute drafting water from an 11-foot lift, salt water, using three lines siamesed into an Eastman deluge set. The connection between the engine and pump is by pinion gears, a three to one reduction, as the pump speed at capacity is 500 revolutions and the engine is 1,500. The engine is all that could be desired."

Tacoma, Wash., Cost Data.

The following comparative cost records are submitted by Mr. Geo. McAlevy, fire chief, Tacoma, Wash.:

AERIAL TRUCK, TRACTOR DRAWN.

(Cost for Twelve Months.)

Cost of repairs, including labor and material	$365.21
Lubricating oil	28.84
Gasoline	82.20
Total cost for twelve months	$476.25
Number of miles traveled	328
Cost per mile	$ 1.45

AERIAL TRUCK, THREE-HORSE DRAWN.

(Cost for Twelve Months.)

Cost of maintenance with same equipment	$924.13
Number of miles traveled	290
Cost per mile	$ 3.18
Cost of repairs, including labor and material	$ 91.86
Lubricating oil	27.79
Gasoline	70.00
Total cost for twelve months	$189.65
Miles traveled	215
Cost per mile	$ .88

HORSE-DRAWN COMBINATION HOSE AND CHEMICAL.

Cost of 3-horse combination, twelve months	$708.58
Number of miles traveled	298
Cost per mile	$ 2.38

PACKARD 3-TON COMBINATION, BORO OF BROWNSVILLE, PA. NINE-TENTHS OF THE LOAD IS CARRIED ON THE REAR WHEELS, GIVING THE MAXIMUM OF TRACTIVE EFFORT FOR SLIPPERY STREETS OR STEEP HILLS. THE POSITIVE BRAKES, CAPABLE OF LOCKING THE REAR WHEELS UNDER FULL LOAD, ARE AN IMPORTANT SAFEGUARD.

PLAIN CHEMICAL.

Repairs, including labor and material	$196.27
Lubricating oil	5.53
Gasoline	38.81
Total expense for twelve months	$240.61
Number of miles traveled	147
Cost per mile	$ 1.63

PLAIN HORSE-DRAWN CHEMICAL.

Cost of 2-horse chemical, twelve months	$465.00
Number of miles traveled	100
Cost per mile	$ 4.65

FIRST SIZE THREE-HORSE-DRAWN STEAMER.

Maintenance 3 horses, seven months	$441.81
Lubricating oil	24.50
Coke and coal	156.24
Repairs	32.70
Total cost for seven months	$655.25
Miles traveled	109
Cost per mile	$ 6.01

EXTRA FIRST SIZE MOTOR AND PUMPING ENGINE.

Repairs, including labor and material for seven months	$176.43
Lubricating oil	19.90
Gasoline	53.00
Total cost for seven months	$249.33
Number of miles traveled	117
Cost per mile	$ 2.13

Blasting Frozen Ground for Sewer Trench

S. R. Bowen, contracting engineer at Mason City, Iowa, in his circular letter No. 30, to the foremen on his work, gave the following description of the methods and results of blasting the frozen soil in starting a sewer trench:

They broke 50 feet of frost on the North Main street sewer this morning in 2½ hours. This material did not fly to speak of, and had a light covering of boiler iron. Two men with a point 3 feet long and a little larger round at the top than the bottom put down the holes in a short time. When the weather was cold they heated the bar. These holes were 18 inches deep and the frost is 2 to 2½ feet deep. After driving the point in they turned it and pulled it out with a 16-inch Stilson wrench.

These holes were placed zigzag in two lines about 18 inches apart. This opened a ditch 3 feet wide, and was taken out by two men.

These holes were loaded with half a stick of 40 per cent. dynamite and exploded with a No. 6 Du Pont electric fuse. The dynamite was Red Cross Extra. Four holes were shot at a time because a plate glass window was within 30 feet of the shots. They have been doing this for several days, and have been able to get in 40 feet of pipe each day with a crew of twenty men. The trench is 15 feet deep in sand and water and has to be sheeted all of the way, and they keep the backfill up to the end of the pipe every day, so it does not have over 24 hours to freeze at the longest. I think that you will be able to make equal or better progress, governed by the class of work you are encountering, and hope to note some improvements on the plan outlined.

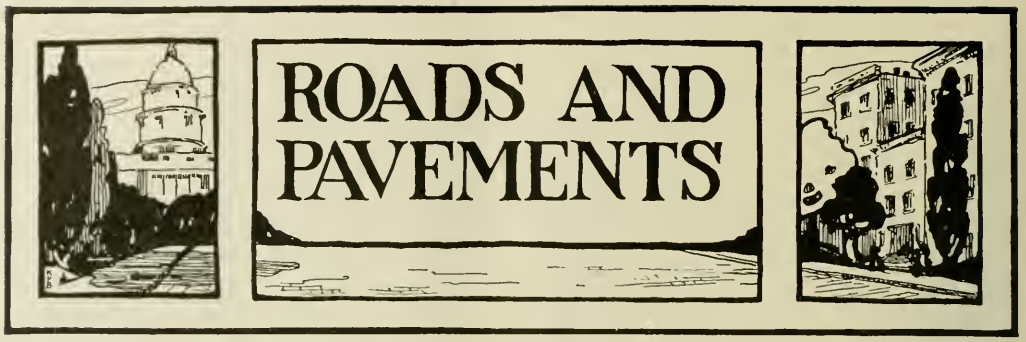
Motor Equipment of Fire and Police Departments

(Continued from page 45 of the "Motor Trucks in Public Service" insert in the April number.)

City or Town—State	Name of Make	Model	Capacity	Cyl.	H. P.	Description	Dept.	No. of Pieces	Years Service	Price of Each	Speed MI. per Hour	Chassis Weight	Special Features
Niles, Mich.	The White Co.	....	1½ ton	4	60	Hose & chemical	Fire fighting	1	1	....	....	....	
Nashville, Tenn.	The White Co.	....	¾ ton	4	30	Patrol	Police	2	2	....	....	....	
Newark, N. J.	The White Co.	....	¾ ton	4	30	Patrol	Police	1	1	....	....	....	
New Britain, Conn.	The White Co.	....	¾ ton	4	30	Patrol	Police	1	1	....	....	....	
New Castle, Pa.	The White Co.	....	¾ ton	4	30	Patrol	Police	1	1	....	....	....	
New Haven, Conn.	The White Co.	....	¾ ton	4	30	Patrol	Police	2	1	....	....	....	
Newport, R. I.	The White Co.	....	¾ ton	4	30	Patrol	Police	1	1	....	....	....	
Norwood, O.	The White Co.	....	¾ ton	4	30	Patrol	Police	1	1	....	....	....	
New York City, N. Y.	Garford	65A	....	4	30	Patrol wagon	Police	10	1	....	25	....	Regulation patrol type
New York City, N. Y.	Garford	H	....	4	40	Patrol wagon	Police	3	1	....	25	....	Regulation patrol type
North Yakima, Wash.	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	3	4	10,500	25	10,000	4 wheel self-contained aerial
New York City, N. Y.	Couple Gear	A	5 ton	4	Batt.	Steamer tractor	Fire fighting	1	4	4,000	17	8,000	2 wheel steamer
New York City, N. Y.	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	4	3	10,500	20	10,000	4 wheel self-contained aerials
New York City, N. Y.	Couple Gear	H	6 ton	4	60	Water tower tractr	Fire fighting	3	4	5,400	20	10,000	4 wheel drive & steamer tractor
New York City, N. Y.	Gen. Motors	15	¾ ton	4	28	Ambulance	Police ambulance	2	1	1,900	20	2,510	Ambulance
New York City, N. Y.	The White Co.	H	½ ton	....	Elec.	Ambulance	Police ambulance	1	2	3,000	12	2,500	Ambulance
New York, N. Y.	Mack	....	3 ton	4	48	Chemical & tanks	Fire fighting	25	1915	4,110	25	....	
New York, N. Y.	Mack	....	3 ton	4	48	High pressure hose	Fire fighting	2	1915	4,625	25	8,500	
New York, N. Y.	Couple Gear	A	5 ton	Batt.		Tractor	Fire fighting	1	4	4,000	17	7,000	
New York, N. Y.	Trumbull	B	¾ ton	4	18		Police		3	395	50	800	
New York, N. Y.	Mack	....	1½ ton	4	32	H. P. hose	Fire fighting	2	4	3,000	18	4,700	
New York, N. Y.	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	2	3½	4,500	25	8,000	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	25	3	4,045	35	4,000	
New York, N. Y.	Mack	....	2 ton	4	32	Supply chemical	Fire fighting	20	3	4,045	35	4,900	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	2	2½	3,300	18	4,900	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	4	2½	4,135	35	4,900	
New York, N. Y.	Mack	....	2 ton	4	32	Instruction truck	Fire fighting	1	2	3,135	35	4,900	

City or Town—State	Name of Make	Model	Capacity	Cyl.	H. P.	Description	Dept.	No. of Pieces	Years Service	Price of Each	Speed Mi. per Hour	Chassis Weight	Special Features
New York, N. Y.	Mack		2 ton	4	32	Comb. chemical	Fire fightnig	3	1	3,250	35	4,900	
New York, N. Y.	Mack		3 ton	4	48	H. P. hose	Fire fighting	10	2½	4,160	25	8,000	
New York, N. Y.	Mack		3 ton	4	48	H. P. hose	Fire fighting	20	1	4,160	25	8,000	
New York, N. Y.	Mack		3 ton	4	48	City service trucks	Fire fighting	10	1/3	5,625	10	7,600	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	1	2	5,000	20	9,000	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	3	1	3,750	20	6,000	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	1	3	5,400	20	10,000	
New Haven, Conn.	Couple Gear	AF	5 ton		Batt.	Tractor	Fire fighting	1	2	4,000	17	8,000	
Newark, N. J.	Mack		3 ton	4	48	Hook & ladder	Fire fighting	1	4	11,000	25	10,000	
North Yakima, Wash.	Couple Gear	A	5 ton	4	65	Aerial ladder	Fire fighting	1	4	11,000	20	10,000	
Oelwein, Iowa	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Ocean City, N. J.	The White Co.		1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Omaha, Neb.	Gen. Motors	15	¾ ton	4	28	Police patrol	Police patrol	1	¾	1,975	25	2,510	Comb. patrol and ambulance
Ocean City, N. J.	The White Co.		¾ ton	..	30	Tractors	Fire fighting	2	...	.....	..	.....	
Ocean City, N. J.	The White Co.		.....	..	30		Chief's car	1	...	.....	..	.....	
Oshkosh, Wis.	The White Co.		3 ton	..	60	Service ladder	Fire fighting	1	...	.....	..	.....	
Ottumwa, Iowa	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Oak Park, Ill.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Omaha, Neb.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Oshkosh, Wis.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Oyster Bay, N. Y.	Garford	66	.....	4	23	Hose & chemical	Fire fighting	1	...	.....	25	.....	Reg. Comb. job
Parnassur, Pa.	Packard	D	3 ton	4	32	Hose & chemical	Fire fighting	1	1-3	4,175	30	6,900	Two 40-gal. Chem. tanks, 3 ladders, 800 ft. of hose
Pawtucket, Conn.	The White Co.		1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Petaluma, Cal.	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Philadelphia, Pa.	The White Co.		¾ ton	..	30	Supply trucks	Fire fighting	3	...	.....	..	.....	
Philadelphia, Pa.	The White Co.		.....	..	60		Chief's car	1	...	.....	..	.....	
Pittsburg, Kans.	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Pittsburg, Kans.	The White Co.		.....	..	30		Chief's car	1	...	.....	..	.....	
Portland, Ore.	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Portland, Ore.	The White Co.		¾ ton	..	60	Chemical truck	Fire fighting	1	...	.....	..	.....	
Portland, Ore.	The White Co.		3 ton	..	30	Supply truck	Fire fighting	1	...	.....	..	.....	
Pottsville, Pa.	The White Co.		1½ ton	..	40	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Poughkeepsie, N. Y.	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Puvalley, Wash.	The White Co.		1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Passaic, N. J.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Philadelphia, Pa.	The White Co.		¾ ton	..	30	Patrol	Police	2	...	.....	..	.....	
Pittsburgh, Pa.	The White Co.		¾ ton	..	40	Patrol	Police	11	...	.....	..	.....	
Poughkeepsie, N. Y.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Providence, R. I.	The White Co.		¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Pt. Washington, N. Y.	Garford	66	.....	4	23	Hose & chemical	Fire fighting	1	1	.....	25	.....	Reg. combination job
Pueblo, Colo.	Garford	65A	.....	4	30	Hose & chemical	Fire fighting	3	3	.....	25	.....	Reg. combination job
Philadelphia, Pa.	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	3	10,500	20	10,000	Self-contained aerial
Philadelphia, Pa.	Couple Gear	H	4 ton	4	60	Tractor for water tower	Fire fighting	1	3	5,000	20	9,000	4 wheel drive tractor
Philadelphia, Pa.	Couple Gear	A	5 ton		Batt.	Tractor for steamer	Fire fighting	1	3	4,000	20	7,000	2 wheel drive tractor
Piermont, N. Y.	Mack		1½ ton	4	32	Hose truck	Fire fighting	1	1	3,035	35	4,800	
Phoenix, Ariz.	Mack		2 ton	4	32	Express	Fire fighting	1	2	3,215	18	4,900	
Providence, R. I.	Auto Car		.....	..	..	Hose & chemical	Fire fighting	1	1	2,900	..	.....	
Paterson, N. J.	Mack		3 ton	4	48	Comb. chemical	Fire fighting	2	½	5,000	25	7,600	
Philadelphia, Pa.	Mack		3 ton	4	48	Comb. chemical	Fire fighting	1	3½	4,950	25	7,600	
Philadelphia, Pa.	Mack		3 ton	4	48	Comb. chemical	Fire fighting	7	1½	5,120	25	7,600	
Philadelphia, Pa.	Mack		3 ton	4	48	Comb. chemical	Fire fighting	4	¼	5,120	25	7,600	
Philadelphia, Pa.	Mack		2 ton	4	32	High pressure hose	Fire fighting	1	3½	3,252	35	4,900	
Philadelphia, Pa.	Mack		2 ton	4	32	Hose wagon	Fire fighting	1	3	3,600	35	4,900	
Philadelphia, Pa.	Mack		3 ton	4	48	Fire	Police	5	3	2,800	20	3,900	
Philadelphia, Pa.	G. M. C.	V	2¼ ton	4	25	Patrol	Fire fighting	1	2	4,000	17	7,000	
Philadelphia, Pa.	Couple Gear	A	5 ton		Batt.	Steamer tractor	Fire fighting	4	4	11,000	20	10,000	
Philadelphia, Pa.	Couple Gear	H	3½ ton	4	60	Aerial	Fire fighting	3	4	5,000	25	9,000	
Portland, Ore.	Couple Gear	H2	3½ ton	4	60	Water tower tractor	Police	1	1	2,500	30	4,000	
Plainfield, N. J.	Federal	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	1	3	3,750	35	4,900	
Quincy, Mass.	The White Co.		1½ ton	..	60	Squad trucks	Fire fighting	2	...	.....	..	.....	
Quincy, Mass.	The White Co.		3 ton	..	60	Service ladders	Fire fighting	2	...	.....	..	.....	
River Forest, Ill.	Packard	D	2 ton	4	25	Hose & chemical	Fire fighting	1	1-12	4,550	30	5,133	Hose, Chem. ladders, etc., in usual Comb.
Rock Island, Ill.	Gen. Motors	15	¾ ton	4	28	Police patrol	Patrol	1	¾	1,975	25	2,510	Com. patrol & ambulance
Reading, Pa.	The White Co.		1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Roland Park, Md.	The White Co.		¾ ton	..	30	Ladder truck	Fire fighting	1	...	.....	..	.....	
Roland Park, Md.	The White Co.		.....	..	30		Chief's car	1	...	.....	..	.....	
Republic of Panama	The White Co.		1¼ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Roselle Park, N. J.	Mack		2¾ ton	4	48	Comb. chemical	Fire fighting	1	1/6	4,000	35	6,000	
Richmond, Va.	Mack		2 ton	4	32	Comb. chemical	Fire fighting	4	½	2,350	30	4,860	
Roslyn, N. Y.	Mach		1½ ton	4	32	Chassis	Fire fighting	1	3	3,000	35	4,800	
Rochester, N. Y.	Mack		1½ ton	4	32	Hose truck	Fire fighting	1	2	2,700	35	4,900	
Rochester, N. Y.	Mack		2 ton	4	32	Chassis	Fire fighting	1	1	2,700	35	4,900	
Rochester, N. Y.	Mack		2 ton	4	32	Chassis	Fire fighting	2	1	2,700	35	4,900	
Rye, N. Y.	Mack		2 ton	4	32	Chassis	Fire fighting	1	2	5,042	35	1,900	

Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Comb. Hose & chemical	Fire fighting	2	3	4,250	35	4,000	Peter Pirsh & Son, hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	D30	1 ton	4	30	Comb. Hose & chemical	Fire fighting	1	5	5,250	35	4,000	Peter Pirsh & Son, hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Comb. Hose & chemical	Fire fighting	1	1-12	4,250	35	4,000	Amer.-La France hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Police patrol	Police	1	3	4,250	25	4,000	Studebaker police patrol body
San Anselmo, Cal	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
San Francisco, Cal	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
San Francisco, Cal	The White Co	....	1½ ton	..	30	Supply truck	Fire fighting	1	...	.....	..	.....	
Santa Anna, Cal	The White Co	....	1½ ton	..	45	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Sioux City, Iowa	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	3	...	.....	..	.....	
Sioux City, Iowa	The White Co	....	3 ton	..	60	Service ladder	Fire fighting	1	...	.....	..	.....	
Southbridge, Mass	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
So. Manchester, Conn.	The White Co	....	¾ ton	..	30	Hose truck	Fire fighting	1	...	.....	..	.....	
Statesville, N. C	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Stockton, Cal	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
St. Louis, Mo	The White Co	....	¾ ton	..	30	Patrol	Police	4	...	.....	..	.....	
St. Paul, Minn	The White Co	....	¾ ton	..	30	Patrol	Police	2	...	.....	..	.....	
St. Paul, Minn	The White Co	....	1½ ton	..	60	Patrol	Police	1	...	.....	..	.....	
San Antonio, Tex	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Sandusky, Ohio	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Saskatoon, Sask	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Savannah, Ga	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Somerville, Mass	The White Co	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Springfield, Mass	The White Co	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Syracuse, N. Y	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Shreveport, La	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	3	.....	25	.....	Reg. Comb. job
South Bend, Ind	South Bend	C80	.....	4	80	Chemical engine	Fire fighting	1	2	5,000	50	5,950	Two 75-gal. tanks
South Bend, Ind	South Bend	H80	.....	4	80	Hose wagon	Fire fighting	2	2	3,500	50	5,950	1,500 ft. 2½-in. hose, 2 ladders, etc
South Bend, Ind	South Bend	H60	.....	4	60	Hose wagon	Fire fighting	1	3	3,000	45	5,700	1,200 ft. hose, 2 ladders, etc.
South Bend, Ind	South Bend	H80	.....	4	80	Ambulance	Fire fighting	1	1½	5,000	50	5,950	Two cots, electric fan, etc.
Springfield, Mass	Couple Gear	H	3 ton	..	..	Hose & chemical	Fire fighting	2	5	5,900	30	6,000	
Springfield, Mass	Couple Gear	HT	6 ton	..	..	Ladder tractor	Fire fighting	1	4	5,200	25	9,000	
Springfield, Mass	Couple Gear	A	5 ton	..	..	Aerial ladder	Fire fighting	3	4	11,000	25	11,000	4 wheel self-contained aerial
San Francisco, Cal	Mack	....	2 ton	4	32	Comb. chemical	Police	2	1	2,500	30	4,000	
St. Louis, Mo	Federal	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	1	3	2,000	15	4,000	
San Jose, Cal	Federal	H	1½ ton	4	30	Sercise car	Police	1	2	2,500	30	4,000	
Sharon Hill, Pa	Sederal M. & T. Co	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	..	2½	.....	15	.....	
Springfield, Mass	International	M	½ ton	2	20	Fire truck	Fire fighting	6	5	11,000	20	10,000	
Tacoma, Wash	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Terre Haute, Ind	The White Co	....	1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Texarkana, Tex	The White Co	....	1½ ton	..	30	Hose & chemical	Fire fighting	2	...	.....			
Topeka, Kans	The White Co	....	.....	..	30		Chief's car	1	...	.....			
Toronto, Ont	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Toronto, Ont	The White Co	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Trenton, N. J	Couple Gear	A	5 ton	4	60	Aerial ladder	Fire fighting	1	3	11,000	25	11,000	4 wheel drive self-contained
Trenton, N. J	Couple Gear	A	5 ton	4	60	Steamer tractor	Fire fighting	2	2	4,500	20	8,000	Front drive steamer tractor
Taunton, Miss	Couple Gear	H	3½ ton	4	60	Hose, chem. & aerial ladder	Fire fighting	1	2½	2,600	35	4,000	
Taunton, Miss	Mack	....	1 ton	4	32	Chassis	Fire fighting	1	1½	2,100	35	4,500	
Trenton, N. J	Mack	....	1 ton	4	32	Chassis	Fire fighting	2	2	4,500	17	8,000	
Visalia, Cal	The White Co	....	1½ ton	..	60	Chemical trucks	Fire fighting	2	...	.....	..	.....	
Visalia, Cal	The White Co	....	1½ ton	..	60	Hose truck	Fire fighting	1	...	.....	..	.....	
Vancouver, Wash	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	4	10,500	25	10,000	4 wheel self-contained aerial
Vancouver, B. C	Couple Gear	A	5 ton	4	65	Tractor	Fire fighting	1	4½	11,000	20	10,000	
Wilmington, Del	Mack	....	2 ton	4	32	Chassis	Fire fighting	1	2	2,800	35	4,900	
Wilkes Barre, Pa	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	1	1/3	4,750	25	7,600	
Washington, D. C	Couple Gear	H	3½ ton	4	60	Aerial	Fire fighting	1	3	11,000	20	10,000	
Wilmington, Del	Couple Gear	H	3½ ton	4	60	Aerial ladder	Fire fighting	1	1	11,000	25	11,000	
Wilmington, Del	Couple Gear	A	5 ton	4	80	Aerial ladder	Fire fighting	1	1	3,100	35	4,800	
Wilkes Barre, Pa	Mack	....	1½ ton	4	32	Hose body	Fire fighting	6	1/4	5,000	25	7,600	
Winnetka, Ill	Packard	H	2 ton	4	26	Hose & chemical	Fire fighting	1	1	4,300	30	5,220	Hose, Chem., ladder, etc., in usual Comb.
West Point, Va	Kelly-Springfield	K31	1½ ton	4	30	Hose & chemical	Fire fighting	1	1½	4,250	35	4,000	Peter Prisch & Son, hose & chemical.
Washington, D. C	The White Co	....	1½ ton	..	40	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Waterville, Me	The White Co	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Waterville, Me	The White Co	....	1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....			
Weston, Mass	The White Co	....	1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....			
Whitehall, Pa	The White Co	....	¾ ton	..	30	Hose & chemical	Fire fighting	1	...	.....			
Wilkes-Barre, Pa	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Wilmington, N. C	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Woonsocket, R. I	The White Co	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Worcester, Mass	The White Co	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Wellsville, Ohio	Garford	65A	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Woodbridge, N. Y	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Wharton, Texas	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Washington, D. C	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	3	10,500	25	10,000	4 wheel self-contained aerial
Wilmington, Del	Couple Gear	A	5 ton	5	90	Aerial ladder	Fire fighting	1	2	11,500	20	11,000	4 wheel self-contained aerial
Yonkers, N. Y	The White Co	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Yonkers, N. Y	The White Co	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	



Prizes for Road Photographs

The National Highways Association offers cash prizes for photographs of roads as follows:

The most striking good or bad road photograph, $500; five second prizes of $100 each; twenty third prizes of $25 each; forty fourth prizes of $15 each; one hundred fifth prizes of $5 each, or 166 prizes in all, amounting to $2,600. The photographs will be used in an exhibit at Washington intended to show the value of good roads. The contest will close November 7 at noon. All photographs should be addressed to Good Roads Everywhere Photograph Contest, National Highways Association, Washington, D. C. Charles Henry Davis, C. E., Cambridge, Mass., is president of the association.

Awards Under Vermillion County, Illinois, Bond Issue

Division No. 1: Awarded to Harding and Slattery, of Crawfordsville, Ind., for concrete, at their gross bid of $116,444; unit price per square yard of pavement, 70 cents.

Division No. 2: Awarded to Granite City Lime and Cement Co., of Granite City, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $234,800 and $128,800; unit price per square yard of pavement, $1.51 and 69.5 cents, respectively; brick to be laid on Dixie Highway.

Division No. 3: Awarded to A. D. Thompson, of Peoria, Ill., for concrete, at their gross bid of $113,053; unit price per square yard of pavement, 70 cents.

Division No. 4: Awarded to Eclipse Construction Co., of Winnetka, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $196,093.82 and $104,784.84; unit price per square yard of pavement, $1.58 and 60 cents, respectively; brick to be laid on Dixie Highway.

Division No. 5: Awarded to Prendergast-Clark Construction Co., St. Louis, Mo., for concrete, at their gross bid of $124,800; unit price per square yard of pavement, 70 cents.

Division No. 6: Awarded to M. J. Herrick, of St. Louis, Mo., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $220,528 and $99,897; unit price per square yard of pavement, $1.81 and 61 cents, respectively; brick to be laid east of Oakwood.

Division No. 7: Awarded to Granite City Lime and Cement Co., of Granite City, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $202,000 and $119,000; unit price per square yard of pavement, $1.49 and 69 cents, respectively; brick to be laid east of Catlin.

Division No. 8: Awarded to P. M. Johnson & Co., of St. Elmo, Ill., for concrete, at their gross bid of $113,200; unit price per square yard of pavement, 61 cents.

Division No. 9: Awarded to Ewing, Shields & Co., of Greencastle, Ind., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $257,000 and $145,980; unit price per square yard of pavement, $1.70 and 72 cents respectively; brick to be laid north of Georgetown. Division No. 9 afterwards awarded to Eclipse Construction Co., who sublet to McCalman Construction Co., of Decatur, Ill.

The contractors, material men and equipment salesmen are outspoken in their praise of the courtesy shown, the facilities and accommodations for work given by the road commissioners and Chief Engineer P. C. McArdle.

There was no question as to detail of construction, choice of material, description of material, grade; in fact, any engineering information at all, that was not furnished at once and fully by the superintending engineer's office. Plans, profiles, cross-sections, quantities of work, every item that could possibly come up for investigation, had been thoroly investigated and the results tabulated and made available for instant use, and the most trivial things were given the same careful attention as the most important.

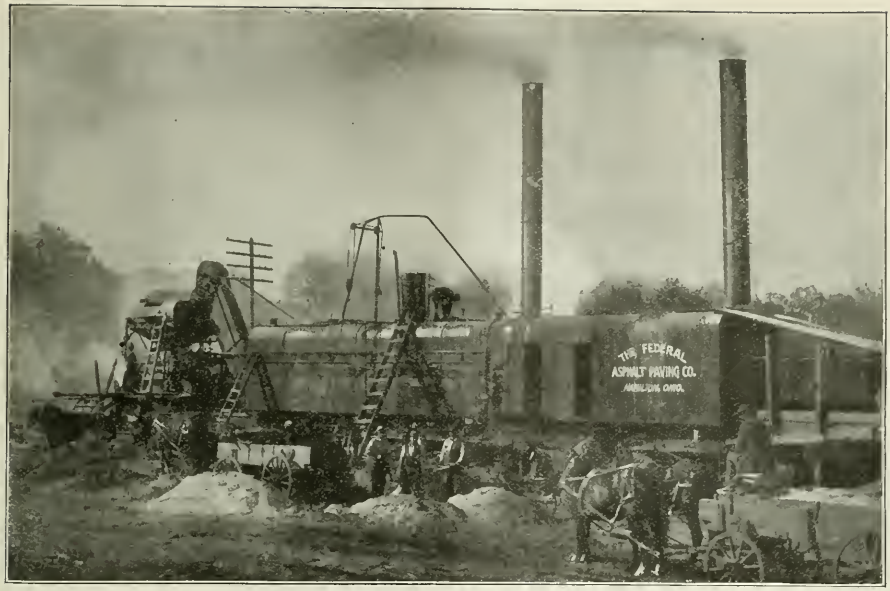
Methods of Prominent Asphalt Contractor

The Federal Asphalt Paving Company, of Hamilton, O., organized during the latter part of February, 1915, completed the work in connection with its contracts on November 26, after a very successful season's operations.

During the season this company laid a total of 122,097 square yards of pavements, all of same being either sheet asphalt or asphaltic concrete. It opened its season's operations in Charleston, W. Va., the third week in April, completing 37,928 square yards of asphaltic concrete pavement on June 30. The equipment was then moved to Marion, O., where 3,325 square yards of sheet asphalt pavement was completed by July 14. A contract at Sandusky, O., for the construction of 9,962 square yards of sheet asphalt was then opened and completed on August 12. From Sandusky, O., the equipment was shipped to Battle Creek, Mich., where the work in connection with the contract with that city was opened on August 18, and completed on September 11, during which time 36,867 square yards of asphaltic concrete wearing surface was laid. Work was then opened in the city of Wabash, Ind., and 16,545 square yards of sheet asphalt pavement completed by October 29, after which the equipment was shipped to Columbus, O., where the laying of 17,470 square yards of sheet asphalt wearing surface was completed on November 26.

ASPHALT PLANT IN OPERATION.

Trinidad Pitch Lake asphalt was used in the construction of all the pavements laid during the year, with the exception of the Charleston, W. Va., work, in which Mexican asphalt was used. The type of construction at Charleston, W. Va., was that known as asphaltic concrete with a 2-inch wearing surface and a 5-inch cement concrete base with a combination cement curb and gutter. At Marion, O., the work was con-



MERRIMAN ONE-CAR ASPHALT PLANT IN OPERATION.

structed under a sheet asphalt specification with a 1-inch binder and a 2-inch wearing surface on a 6-inch cement concrete base with a straight stone curb. Sheet asphalt with 1¼-inch binder and 1¾-inch wearing surface on a 6-inch cement concrete base, with cement combination curb and gutter, was the specification under which the Sandusky work was constructed. At Battle Creek, Mich., the specifications called for a 5-inch cement concrete base, with a 2-inch asphaltic concrete wearing surface. At Wabash, Ind., sheet asphalt, 1-inch binder, with 1½-inch wearing surface on 6-inch cement concrete base, with straight cement curb, was the specification under which the work was constructed. At Columbus, O., sheet asphalt, 1-inch close binder, with a 2-inch wearing surface laid on 6-inch cement concrete base, with straight Berea stone curb, was the specification.

The Merriman one car railroad portable asphalt plant was used for mixing and preparing the asphalt in connection with the above mentioned work. This type of asphalt plant heats the asphalt with steam, thereby preventing the overheating and burning of the asphalt cement during the course of preparation. It is provided with separate bins for heated stone or sand of various sizes, enabling the operator to get a perfect gradation of the materials for pavement mixtures.

MAKING A REPAIR.

In connection with the Charleston, W. Va., work, this plant mixed the material for an average of 2,209 square yards of pavement per 10-hour day, with 2,615 square yards as the largest output of any single day. At Battle Creek, Mich., this plant mixed the material necessary for an average of 2,348 square yards per 10-hour day, with 3,018 square yards as the largest output of any single day. An accompanying photograph shows the Merriman plant in operation during the construction of the Battle Creek pavement.

One of the accompanying cuts shows the operations necessary to making a repair in an asphalt pavement, produced from photographs taken at Wabash, Ind., where the street was being repaired after eighteen years of service with less than two cents per square yard maintenance during that period. These pictures show the ease with which an asphalt pavement can be repaired.

All of the work laid by The Federal Asphalt Paving Company during the year 1915, was constructed under the general supervision of the company's general manager, F. D. Sheley, who has had several years of experience in the construction of asphalt and other types of pavement. The setting of the asphalt mixtures is all under the supervision of the company's chemist, O. L. Butterbaugh, who not only graduated from the best school of asphalt chemistry in the United States, but has had years of experience in this line of work.

Aside from the asphalt plant proper, the company is equipped with concrete mixers, wagons, and all other machinery and tools necessary for the construction of the various types of street pavements, and has a complete organization of skilled foremen and workmen, and while it specializes in the laying of asphalt pavements, it does not expect to confine its operations to this alone if afforded an opportunity to construct other types of pavements where same are desired.

RECORD TIME ON FOUR CONTRACTS.

The following summary gives yardage laid and time consumed in actual work on four contracts from the above description:

Charleston, W. Va.—Laid 29, 386 square yards 2-inch asphaltic concrete in 133 hours, an average of 2,209 square yards per 10-hour day, with 2,615 square yards as the largest output of any single day.

Sandusky, O.—Laid 9,962 square yards of sheet asphalt with 1¼-inch binder and 1¾-inch top in 67 hours, an average of 1,486.8 square yards per 10-hour day.

Battle Creek, Mich.—Laid 36,865 square yards 2-inch asphaltic concrete in 157 hours, an average of 2,348 square yards per 10-hour day, with 3,018 square yards as the largest output of any single day.

Wabash, Ind.—Laid 10,968 square yards sheet asphalt pave-

THE OPERATIONS NECESSARY IN REPAIRING AN ASPHALT STREET.

CUTTING OUT THE DEFECTIVE SPOT.
TAMPING THE HOT ASPHALT MIXTURE IN PLACE.
PAINTING THE EDGES WITH ASPHALT CEMENT.
THE COMPLETE PATCH THOROLY ROLLED AND COMPACTED.

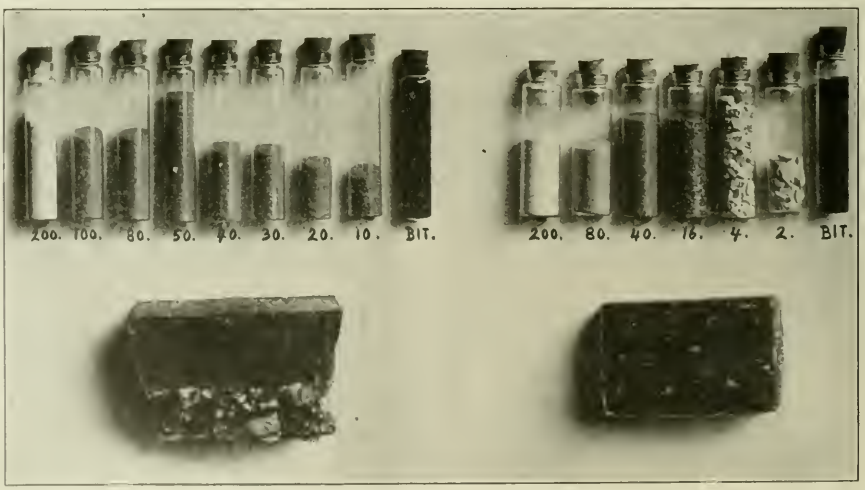
ment with 1-inch binder and 1½-inch top, an average of 1,482 square yards per 10-hour day.

EQUIPMENT USED.

Following is list of equipment used by The Federal Asphalt Paving Company on work herein described:

1 Merriman (large size) portable asphalt plant.
1 Ten-ton Kelly-Springfield asphalt roller.
1 Five-ton Kelly-Springfield asphalt roller.
1 Foote No. 6 "A" concrete mixer.
1 Car load Troy "Ajax" asphalt wagons.
1 Car load Moore grade dump wagons.
1 Chemist's asphalt laboratory outfit.
1 Ford roadster.

Plows, rooters, wheelbarrows, blacksmith tools, shovels, picks and six other small tools necessary.



SHEET ASPHALT 1½-INCH TOP TAKEN FROM MIAMI STREET, WABASH, IND., AFTER NINETEEN YEARS OF SERVICE.

ASPHALTIC CONCRETE 2 INCHES THICK, TAKEN FROM A STREET IN BATTLE CREEK, MICH., LAID BY THE FEDERAL ASPHALT PAVING COMPANY.

Strong Bond in Monolithic Pavement

The successful practical construction of monolithic brick pavements has opened a new field of theoretical engineering investigation. Whenever materials are combined to form an engineering structure, there enters the problem of economically distributing them in order that the structure as a whole may benefit most advantageously by the individual properties of the several elements. Thus in monolithic brick pavements the surface is composed of a material well adapted to resist attrition and compression, supported and held in place by a material well adapted for its purpose. Economic design then demands an equitable adjustment of these two elements in order that maximum serviceability may obtain with a minimum expenditure of money.

The mechanical properties of pavements have been too little understood in the past, and the tests conducted by the University of Illinois, being the first performed upon this type of construction, are worthy of careful study. Tests in bending were performed upon four slabs built as follows:

No. 1. Three-inch brick were laid upon 4 inches of 1:2:4 concrete, upon the surface of which was spread a ¼-inch layer of 1:5 dry mixture of sand and cement, to provide a smooth surface upon which to lay the brick. Joints between the brick were filled with 1:1 cement grout. The slab was allowed to harden for 24 hours and cured with damp sand for 27 days thereafter. Upon completion of the slab, the outside dimensions were 23 by 45 inches, with a total depth of 7 3/16 inches.

No. 2. Similar to No. 1, but 4-inch brick were used in place of 3-inch, as in No. 1.

No. 3. Four-inch brick were laid upon a 1-inch base of 1:3 dry mortar. The dimensions of the slab agreed with those of Nos. 1 and 2, excepting the total depth, which in this case was 5 inches.

No. 4. This slab was constructed 7 inches thick, of plain concrete, intended to represent standard concrete pavement construction.

These slabs were tested in bending at an age of 28 days, with a 42-inch span, the load being applied upon the one-third points, with the following results:

Slab No.	Total Load.	Modulus of Rupture.
1	13,100	465
2	21,500	580
3	6,700	490
4	12,500	460

Comment on Tests.

Slab No. 1. As noted in the accompanying photograph, the fracture of the slab extended squarely thru the brick and concrete, in the first three rows of brick. For the remainder of the width there was a slight separation of the brick and concrete, evidenced by the different planes of fracture of the brick and concrete.

No. 1. No. 2. No. 3. No. 4.

Slab No. 2. This slab showed a square fracture thru the brick and concrete for the entire width of the slab. There was no separation of the brick and concrete.

Slab No. 3. This slab also showed a square fracture for the entire width.

General Conclusions.

While the number of tests was inadequate to furnish conclusive evidence, nevertheless certain conclusions may be drawn justifiably.

1. That it is possible to develop a sufficient bond between the brick and concrete to withstand all ordinary deflections of the pavement.

2. That altho there was no bond failure between the brick and concrete, there was a distinct line of demarkation between the concrete and the layer of sand and cement spread on the surface upon which the brick were laid. The tests served to show the desirability of increasing the richness of this dry mixture to at least a 1:3 in place of the 1:5 mix used.

These tests were performed at the University of Illinois, under the direction of C. C. Wiley, instructor in highway engineering, and are a portion of a series of tests being carried on in the same line of investigation.

Battle Tactics and the Paved Highway

Mobility Can Take the Place of Numbers Better than Numbers Can Replace Mobility

By P. S. Bond, Major, Corps of Engineers, U. S. Army; Member of the American Society of Civil Engineers.

The usefulness in war of a substantial system of highways can scarcely be overstated, but it can be misunderstood and frequently is. Our freedom from wars, during long periods, has made the term "military road" little more than an historical phrase in America. It calls to mind the Cumberland pike and suggests the conditions of military enterprise that gave rise to our constitutional provision for federal military roads.

Those conditions antedate the railroad. In the present state of affairs the longer hauls for the assembling of soldiers, munitions and supplies will almost invariably be made by rail. Military considerations do not call for long single lines of road thru the interior of the nation so much as for intensive systems of parallel and intersecting roads in the probable zones of actual warfare in case of attack by a foreign enemy.

To appreciate the tremendous usefulness of such road systems, it may be necessary to review some of the conditions of modern war as exemplified in Europe today. In speaking of innovations, I use the word with respect to popular American conceptions of war, which are still largely founded on the civil war of the sixties. The European war has really developed very few innovations, from the standpoint of the military student. Attacks by gas and liquid fire, effective as surprises, have been among these few. The general nature of the struggle was either anticipated by military men or actually demonstrated in the other wars of the last two decades. I wish particularly to refer to some phases of modern war with reference to the use of highways.

While less reliance than formerly is placed upon permanent fortifications, trench warfare between nearly equal forces tends to develop a condition of deadlock, in which the tactics are similar to those of a siege. Hence the routes of supply do not, under certain conditions, vary as much as in the old days of open fighting when one army would pursue another half across a continent on foot.

Not only are routes of distribution more permanent, but the volume and weight of the traffic is such as to justify and require the most substantial kind of highways. Larger armies eat more food. Larger and more intricate guns consume immensely more ammunition. The British army in Belgium is said to have fired more shells in a single day than were used in the entire Boer war. These are transported from the railroad terminals to the place of consumption very largely by motor truck and the effect on any but the most substantial roads can be imagined.

Add to these conditions the mobility now required for very heavy guns. It can be seen that the placing and replacing of ordinance weighing many tons per piece—the saving of guns in case of a sudden retreat—would be virtually impossible under the conditions that prevail on most American highways during long seasons, or would impose the heaviest possible tasks upon the engineering arm of the service.

We have pictures showing the kind of improvised roads upon which the resourceful Germans have been compelled to rely in Russia. They follow the principles of the old American cordnroy road, with a foundation of stringers and transverse logs, on which are laid brush and dirt. The contrasting advantages of level durable road surfaces, prepared in time of peace with an eye to the exigencies of war, are so striking as to make comment unnecessary.

But the greatest advantage of motor trucks and suitable motor roads has yet to be mentioned. To appreciate it, one must bear in mind the broad nature of battle tactics. War is not unlike football. An army must hold the foe in check at all points on the line and relies for its success upon smashing attacks by the concentration of troops at some particular point. In the old days the plan of attack was often concealed from the enemy until the moment it was sprung. Distance and natural obstacles to vision made it possible to work out maneuvers with comparative leisure. Today the hostile aeroplane hovers overhead and conveys prompt information of the concentration of any considerable body of troops at any given quarter.

To render such an attack effective, it is therefore necessary to make it a sudden attack, like the dash of the backfield in a football game. To be able to move a whole division by truck and auto to a critical point at a rate of twenty or thirty miles an hour would greatly facilitate both offense and defence. It is said that the battle of the Marne was won by the sudden concentration of French troops, using motor transport over the splendid chaussees of France, upon the German left wing.

One road will not suffice for this variety of tactics, although one is better than none. The ideal would be a number of parallel routes traversing the line of battle, with frequent cross roads to permit the distribution of reinforcements at any desired point or points. In war, football or chess there is only one rule for success and that is to oppose a lesser force with a greater force at the crucial point in the conflict. This does not mean that the largest army always wins, for the largest army may have three quarters of its numbers out of action thru lack of general-ship or failure of transport facilities. Mobility can take the place of numbers much better than numbers can be made to take the place of mobility. When this fact is digested, the immense tactical value of paving can be better appreciated.

The motor can thus lessen the fatigue of forced marches and increase their possible radius five fold or more. It is also probable that motors will take over part of the work of transport formerly accomplished by rail. There is considerable necessary delay in entraining troops and getting a clear track for their movement, so much so that the old rule was to undertake movements of thirty miles or less on foot, as being prompter than train service. With suitable roads and an abundance of motor vehicles, this line of demarcation might be placed at sixty or a hundred miles or more, depending on the particular circumstances of the case.

The unimproved highway is our weakest link today from the standpoint of military transport. America has the railroads. It has the autos and auto trucks. Whether the latter can be used, or whether we must go back to the age of the mule whacker and the dreary march rests with those who are responsible for our highway improvements. Any city within a hundred miles of our coast or frontier may some day be the base of military operations that will put its surrounding highways to the severest test. Very few would meet it creditably. Cuyahoga County, surrounding Cleveland, would offer a better opportunity for modern maneuvers than any similar locality with which I am familiar. The brick road, properly constructed, stands high in the estimation of army men for such purposes as I have been describing.

In a military crisis such a system of roads would much more than pay for itself in the saving of other forms of military expenditure. Considering also how they conduce to the wealth of the nation in times of peace, there seems to be no possible argument against this phase of preparedness.

Records of Street and Road Repair

In a paper before the American Association for the Advancement of Science, Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, makes a plea for the application of system to street management.

Mr. Blair carries the same idea into the taking of a traffic census and in a discussion of that subject before the American Society of Municipal Improvements he objected to the lack of information as to the exact character of the road for which a traffic census is taken.

If a traffic census is taken on a water-bound macadam road with no more information than may be inferred from the name, it is no guide to a correct conclusion as to the worth of water-bound macadam roads. The same is true with reference to all types of roads. The recorded information must give the most accurate and minute information as to exactly how it was built.

He cites brick roads which show very great depreciation in a comparatively short length of time, under little travel, and, on the other hand, brick roads from twenty to twenty-five years of age, bearing heavy traffic, that do not show any marked depreciation.

The same is true of measures of tractive resistance. A Medina stone pavement on one street offers extreme tractive resistance, yet it is not so old as another Medina stone street upon which the tractive resistance is apparently at a minimum.

Good Roads Notes

Oakland, Cal., holds the first Pacific coast motor power and automobile show in its new municipal auditorium April 26 to May 6. The show occupies 50,000 square feet of space. A large percentage of the net receipts will be used by the committee of the Oakland Chamber of Commerce on the Lincoln Highway to pay the expense of making that trunk line as far east as Salt Lake City. L. E. Warford, the special Pacific coast representative of the Lincoln Highway Association, is secretary of the show.

Altho no roads have been constructed in Alaska as yet which are considered good enough to be called automobile routes, the 901 miles of wagon roads which the U. S. Government has built at an average cost of 3,000 a mile, are used by many automobile stages, trucks and smaller vehicles and the saving in cost of transportation in one year, over the former roadless condition was over $2,000,000, or a saving in one year of two-thirds the total cost of roads, winter sled roads and trails since 1906.

MISCELLANEOUS

The March of Events

May 8-10, at Waco, Tex., Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Tex.

May 9-11, in auditorium of Insurance Exchange, Jackson boulevard and LaSalle street, Chicago, National Fire Protection Association. Headquarters at LaSalle Hotel. Franklin H. Wentworth, secretary, 87 Milk street, Boston, Mass.

May 10-17, at Indianapolis, Ind., National Conference of Charities and Corrections. W. T. Cross, general secretary, 315 Plymouth Court, Chicago, Ill.

May 16-19, at New York, National District Heating Association. D. L. Haskill, secretary, Greenville, O.

May 17-20, at Galveston, Tex., Southwestern Electrical and Gas Association. H. S. Cooper, secretary, Slaughter building, Dallas, Tex.

May 22-26, at Congress Hotel, Chicago, Ill., National Electric Light Association and Electric Vehicle Association of America. A. Jackson Marshall, secretary, E. V. A. A.; T. C. Martin, secretary N. E. L. A., 29 West 39th street, New York.

May 31-June 2, at Syracuse, N. Y., New York State Conference of Mayors. W. P. Capes, secretary, New York City.

June 5-7, at Cleveland, O., National Conference on City Planning. Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass.

June 5-9, at New York, American Water Works Association. J. M. Diven, secretary, 47 State street, New York.

June 25-30, at the University of Pennsylvania, Philadelphia, Pa., The Associated Advertising Clubs of the World. C. A. Clark, secretary.

June 27-30, at Pittsburg, Pa., American Society of Civil Engineers. Charles Warren Hunt, secretary, 220 West 57th street, New York.

June 27-July 1, at Atlantic City, N. J., American Society for Testing Materials. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Pa.

Oct. 9-13, at Robert Treat Hotel, Newark, N. J., American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin buildings, Indianapolis, Ind.

Feb. 5, 1917, at Mechanics' Hall, Boston, Mass., American Road Builders' Association meeting, road congress and good roads show. E. L. Powers, secretary, New York.

Engineering Co-operation

The conference of the committee on engineering co-operation in Chicago, April 13 and 14, spent its time in exchanging reports of the problems and successes of the forty-two societies directly or indirectly represented and asked Prof. F. H. Newell and a sub-committee to formulate a plan for promoting co-operation of the engineering societies on general matters of advantage to the profession at large or in its various branches. The plan is to include national, state and local organizations and local branches of national organizations.

Municipal Auditorium for St. Louis

As a part of the expense of the Shakespearean Tercentenary Celebration, to be held June 5 to 11, the St. Louis Pageant Drama Association has constructed in one of the city parks an outdoor auditorium which will be turned over to the city without cost to it and will afterwards be available for any form of wholesome entertainment for which no admission fee is charged.

Chicago Engineers Inaugurate Preparedness Campaign

A group of prominent engineers and contractors of Chicago and vicinity have co-operated in forming a Joint Committee on Military Engineering. The founders are members of all the leading engineering and contracting organizations of Chicago, including the local branches of the national engineering societies.

The purposes of the committee are to further military preparedess among engineers, contractors and their associates by the following means:

1—Courses of lectures.
2—Assigned reading.
3—Studies and practical instruction in military engineering.
4—Assisting engineers to qualify as officers in the National Reserve Corps of Civilian Engineers.
5—Urging enlistment in and support for engineer troops of the National Guard and such other organizations as the Government may create.
6—Furthering instruction in military engineering in training camps and the attendance in them of those qualified.
7—By such other means as from time to time may be deemed advisable.

The Joint Committee has already prepared a program covering the vital points outlined. The program is practically complete for a period extending from April 20 to July 25. Something of interest will be taken up each week, including lectures by Lieutenant-Colonel W. B. Judson, Engineer Corps, U. S. Army; two lectures by Major P. S. Bond, Engineer Corps, U. S. Army; Lieutenant-Colonel Mason M. Patrick, Engineer Corps, U. S. Army, and several exhibition drills, terrain exercises and inspection trips under the direction and guidance of various officers of the engineer troops of the Illinois Na-

tional Guard. Additions to the program will be made from time to time.

Engineers, contractors and their associates in Chicago and vicinity are invited to join the Joint Committee on Military Engineering. Correspondence should be addressed to the secretary, Robt. F. Hall, 111 West Washington street, Chicago.

Personal Journalism in Advertising

E. C. Tibbitts, the only advertising manager The B. F. Goodrich Company, of Akron, O., has ever had, has just concluded his nineteenth year in that capacity. He has no one with whom to divide the responsibility and the credit for the peculiarly effective advertising for which his company has become famous, and it is fitting, therefore, that a touch of the old-fashioned personal journalism should be given by putting his name to the front as the man who has put his impress upon the Goodrich business from the publicity side. He could not have succeeded without high-grade products behind him, and the Goodrich products, from the bottle nipples to Silvertown tires, are of the best. But these good products could not have reached their present popularity without correspondingly good publicity, and for this Mr. Tibbitts is alone responsible.

Septic Tank Patents

The National Septic Process Protection League has been organized with Dr. H. M. Bracken, executive officer of the State Board of Health, St. Paul, Minn., as president; A. E. Kimberly, consulting sanitary engineer, Columbus, O., as vice president, and Frank G. Pierce, secretary of the League of Iowa Municipalities, Marshalltown, Iowa, as secretary-treasurer. The executive committee includes Dean A. Marston, of the engineering department of Iowa State College, Ames, Iowa; C. A. Haskins, engineer of the State Board of Health, Lawrence, Kans.; Paul Hausen, engineer of the State Board of Health, Springfield, Ill.; Wm. J. Locke, secretary of the League of California Municipalities, San Francisco, Cal., and W. P. Capes, secretary of the New York conference of mayors, Albany, N. Y.

The purpose of the league is stated in its constitution to be "to give legal advice an ddefend any suits brought by the Cameron Septic Tank Company against any municipality, company, corporation, state institution or private individual which is a member of this league, when such suit involves the validity of any patent claimed by such company." Assessments for expenses range from $5 for a private individual to $25 for a city of more than 50,000 population, and no assessment except the first can be made without the approval of three-fourths of all the directors, of which there are two from each state.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows.

May 9: Valuation analyst, under Interstate Commerce Commission for work mainly in Washington. First grade, $3,600 to $5,000 a year; second grade, $1,800 to $3,200 a year.

May 17, 18. Heating and ventilating engineer and draftsman in office of the Supervising Architect, Treasury Department, Washington, D. C., at $1,200 a year.

Personal Notes

R. T. Stull, ceramic engineer of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O., was elected an honorary member of the Paving Brick Institute at the recent meeting at Portsmouth, O.

Frank Koester, consulting engineer, 50 Church street, New York, has recently completed a report and plans for the systematic development of the city of Allentown, Pa.

Alexander C. Brown, vice president of the Brown Hoisting Machinery Co., Cleveland, O., has been appointed general manager.

Charles P. Light, for some years field secretary of the American Highway Associatin on May 1, associates himself with the Fidelity Mutual Life Life Insurance Co., of Philadelphia, as a manager with offices at 1423 G street, N. W., Washington, D. C.

Rankin Duval has been appointed road engineer of Scott county ,Ky., with headquarters at Georgetown. The county has voted $100,000 bonds for road construction.

Hansen and Coulter is the style of a new firm of hydraulic and sanitary engineers at 2 Rector street, New York. Mr. Hansen has had some twelve or fifteen years of varied and valuable experience in water and sewerage and house drainage and plumbing, and Mr. Coulter has had about fifteen years' experience in the same lines, including three years on trades wastes disposal.

F. H. Shaw, in addition to his office at Lancaster, Pa., has opened an office at 2307 Woolworth building, New York. Mr. Shaw designs and constructs water, gas, sewerage, railway and hydro-electric installations.

John R. Graham is the new commissioner of streets of Lynn, Mass., having been promoted from general foreman on the death of his predecessor.

Geo. W. White is county surveyor and road engineer of Jefferson.

B. C. Brenner is re-elected city engineer of Kenosha, Wis., for the fourth time.

James Allen is the new State Highway Commissioner of Washington, at Olympia, and Geo. F. Cotherill the new chief engineer.

W. L. Benham is the new city engineer of Blackwell, Okla.

Chester E. Albright is the new chief engineer of the Bureau of Surveys in the Department of Public Works of Philadelphia, Pa.

Frank P. Cobb is city engineer of Chicopee, Mass.

Philip W. Henry, consulting engineer, New York, has been elected vice president of the new American International Corporation to develop American foreign trade. His engineering and business experience in this and other countries fits him exceptionally for this application of his eminent abilities.

C. R. Sumner is city engineer of Hermosa Beach, Cal.

G. W. Cunard is city engineer of Port Angeles, Wash.

H. O. Swoboda, consulting electrical and mechanical engineer, Empire building, Pittsburg, Pa., has been employed by the Boro of New Brighton, Pa., as consulting engineer to plan a new street lighting system.

Col. J. W. Howard, consulting engineer for roads and pavements, New York City, has dropped his suit for slander against Chief Engineer Morris R. Sherrerd, of the Newark, N. J., Department of Public Works, arising out of the controversy about the Market street wood block pavement some eighteen months ago, Mr. Sherrerd having disclaimed any intention of injuring Mr. Howard by any statements he actually made and having asserted the inaccuracy of the newspaper reports of his statements.

L. D. Beckley has opened an office at 2931 Woodward avenue, Highland Park, Mich., a suburb of Detroit, for the practice of general engineering work, paying special attention to municipal improvements and surveys.

MACHINERY AND SUPPLIES

New "P & H" Corduroy Back-Filler

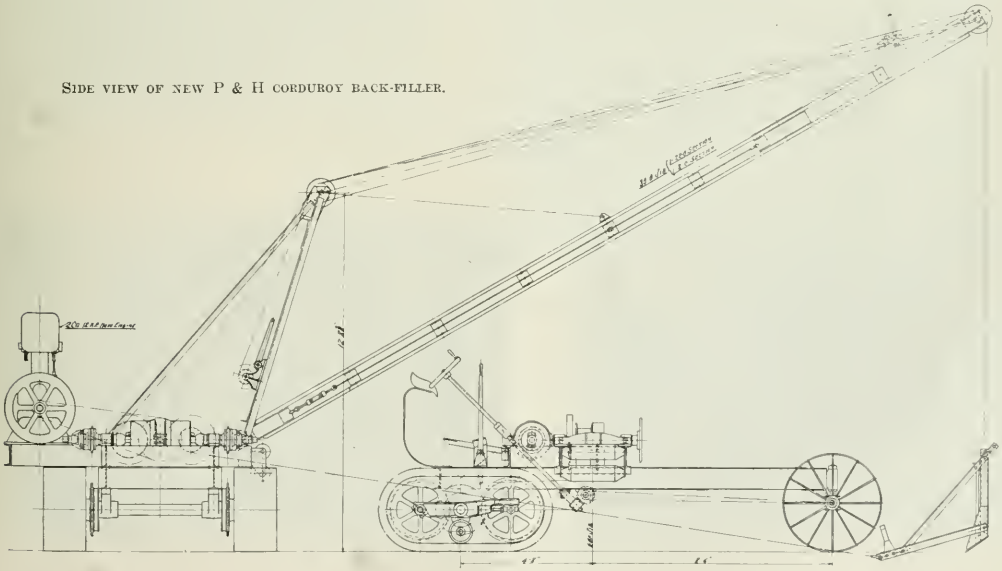
By J. D. Rankin, C. E.

We are showing general arrangement tracing of late type of "P. & H." corduroy-grip-type back-filler, recently made for a firm of prominent Chicago contractors. This machine, which possesses all of the advantages of corduroy traction, is especially suitable for use on mucky footing. It is of the drag-line-excavator type and is designed to backfill all ditches ordinarily cut with trench excavators for water, gas or sewers. All gears are made either of steel forgings or of the best semi-steel castings. All spur gears and pinions have teeth cut from the solid. All bearings are lined with the best babbitt metal and all clutches are friction clutches of the internal expanding ring type lines with asbestos clutch lining.

The front or steering wheels are 42 inches diameter by 12 inches face with plate steel tires and steel spokes cast into heavy iron hubs. The axle is composed of two 6-inch channels, between which are bolted the 2⅜-inch diameter wheel journals, which are readily removable if necessary on account of wear or for other reasons. The axle is pivoted both vertically and horizontally, providing a 3-point support for the car body and preventing distortion of the structure when passing over uneven ground.

Corduroy-grip tractions are provided for supporting the rear of the machine. These tractions are each 18 inches wide by approximately 36 inches between center lines of end sprocket shafts. They are driven by means of chains from the propelling shaft. The two driving sprockets are equipped with slip frictions, either of which can be thrown out of engagement when maneuvering in confined spaces. The main frames of the corduroys are steel castings independently pivoted on the rear axle so that they will accommodate themselves to inequalities in the ground without straining the car body. The traction chains are made of steel casting links with hardened forged steel pins. The supporting blocks are of hardwood, fitted on their upper surface with steel plates. The pressure between the supporting blocks and main frame is taken by the steel casting end sprockets and by a pair of chilled iron intermediate rollers. The general design of tractions is such that they can easily be dismantled for repairs.

The main machinery consists of one intermediate shaft, chain-connected to the engine, and two drum shafts, gear connected to the intermediate shaft. The pinion on the intermediate shaft is a steel forging with teeth cut from the solid. The gears on the drum shafts are of semi-steel also with teeth cut from the solid. The drums run loose upon the shafts and are connected thereto by means of internal-expanding-ring-type clutches 15 inches diameter by 2½ inches face, lined with as-

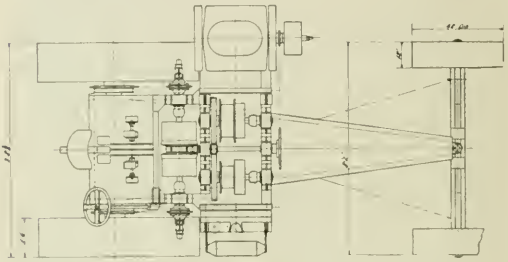


Side view of new P & H corduroy back-filler.

bestos clutch lining. The drum for the pulling rope is 10 inches diameter. The drum for the hauling rope is 15 inches diameter. Both ropes are ½ inch diameter. The intermediate shaft is connected to the engine by means of a high-speed roller chain of 1¼ pitch. An internal-expanding-ring clutch is provided on the engine shaft, enabling all machinery to be placed out of action and the engine to be started without a load.

A steel bevel pinion on the end of the intermediate shaft is provided, meshing with two semi-steel bevel gears on the propelling shaft. These gears are provided with internal-expanding-ring asbestos-lined friction clutches, by means of which propelling motion is obtained in either direction. The connection between this shaft and corduroys is as hereinbefore mentioned. The propelling speed is approximately 1 2/10 miles per hour.

The steering machinery is mounted under the car body and



HORIZONTAL SECTION OF NEW P & H CORDUROY BACK-FILLER.

is operated by a worm and worm wheel, which are self-locking. Connection between this shaft and the front axle is by means of chains. Cushion springs are provided to check the shocks occasioned by obstructions in the road. The steering shaft is hand operated, a large hand wheel, with handle being provided for this purpose.

The operating levers are located at the rear of the machine and so grouped that they can all be reached from one position.

A jib 22 feet long with 8-foot extension, making a total length of 30 feet, is provided. This jib is built up of timber construction and is arranged to swivel approximately 4 feet on either side of the center line. This allows the scraper to be moved to this extent without moving the machine. Adjustment for the jib is obtained by means of a hand winch mounted on the uprights of the car body.

A self-acting scraper 4 feet wide and built up of steel plate, angles and oak planks, is provided for handling the dirt. The design of this scraper is such that no men are necessary to guide it when at work.

This machine, which is manufactured by the Pawling & Harnischfeger Co., Milwaukee, Wis., is driven by a 12-h.p. 2-cylinder vertical hopper-cooled engine, running at 400 r.p.m., provided with a friction clutch of the internal-expansion-ring type and connected to the machinery by means of a high-speed roller chain, as hereinbefore specified. The fuel tank is located in the base of the engine, pump being provided to deliver the fuel to the mixer. The engine is provided with an efficient governor for regulating its speed.

The general dimensions are as follows:

Out to out of corduroys	8 feet, 2½ inches
Wheel base	13 feet, 2 inches
Height without jib	13 feet, 1 inch
Weight, in working order, approximately	14,500 pounds

Gardner Portable Air Compressor

We are illustrating one of the Gardner portable air compressor outfits operating calking tools on one of the city water mains, Sacramento and Avondale Avenues, Chicago. This work was done by day labor of the Bureau of Engineering, Division of Water Works Extension, City of Chicago.

These plants, as illustrated, are equipped with enclosed self-oiling compressors, having separate water cooling system to that of the engine. Are very simple and require but little attention to keep them in good working condition. The entire freedom from intricate mechanisms, requiring delicate adjustments, makes them especially valuable for use in places where best care and attention are not always available. The air tanks are of ample proportions and allow of a large storage of air.

The gasoline engine is of the 4-cylinder, 4-cycle, long-stroke, vertical, heavy-duty type, specially designed for portable compressor work, and is guaranteed to stand up under the hard work that air compressor service requires. Complete with carburetor, magneto, etc. The speed is controlled by fly-ball-type governor, which is adjustable when running or idle, and can be sealed to prevent tampering.

The jackets of the cylinders are kept cool by specially designed radiator, or cooling tower. A safety starting coupling is provided to enable the operator to start the engine easily and to eliminate the much feared back kick. In addition to five large main bearings an outboard bearing is provided to take care of any strain that may come on the bearing when compressor unloader cuts in instantaneously against the full load.

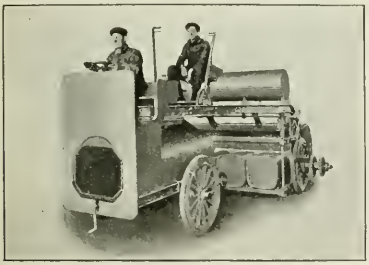
The compressors illustrated were built by The Gardner Governor Co., Quincy, Ill.

GARDNER PORTABLE AIR COMPRESSOR ON CHICAGO CALKING JOB.

Motor Pick-Up Sweeper

We are illustrating a recent type of motor-driven pick-up sweeper as perfected by the Baker Mfg. Co., Springfield, Ill.

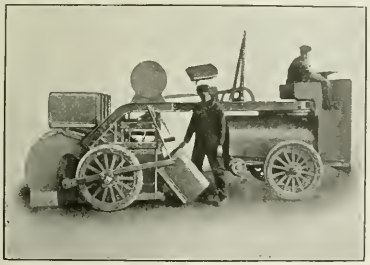
It will be noted that there is room enough in the two carrying racks of the sweeper for eight extra half-yard cans besides the four cans which are furnished with the machine. The helper removes the cans when filled, replaces them with empty ones, puts filled ones in place of empty ones on the rack



until all are filled; then the sweeper carries the picked up litter to a convenient transfer station. The cans are either emptied on the dumping ground or into waiting wagons.

The width swept is 7 feet. Thus, a 25-foot street requires but four trips from gutter to gutter. Since this motor will operate from 18 to 20 miles on a gallon of gasoline, you can easily figure how cheap its operation will be per mile of streets.

This outfit is driven by a 4-cyl., 30-h.p. motor. The machine over all measures 17 feet in length, 10 feet in width and is 6 feet 7 inches high.



New Type of Excavator

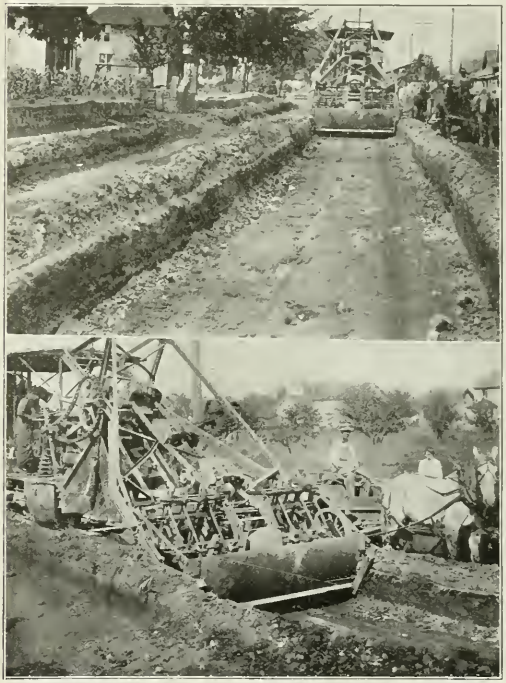
Last season, 1914, the General Engineering and Construction Co., of Rockford, Ill., subcontractors for municipal street work, perfected a new type of grading and excavating machine, which seems to meet in a very practical way, certain conditions in street excavation, not met by any other machine.

This machine is particularly adapted to grading in connection with street paving work, especially where it is desirable or necessary to haul the dirt in dump wagons and where space is limited as in many points.

It is also adapted to excavating trench for street railway tracks. This machine cuts a strip 8½ feet wide, and will excavate 2 or 3 inches deep, or as deep as 5½ feet, the cutting wheel working on a boom being instantly adjustable by a screw raising or lowering. An indicator is provided so that the operator can run true to a grade line. The earth is deposited in dump wagons and the production is so uniform that the number of teams can each day be properly proportioned to the length of haul, so that there will not be over half a minute lost team time at the machine on each trip. This is one of the points of economy in using the machine.

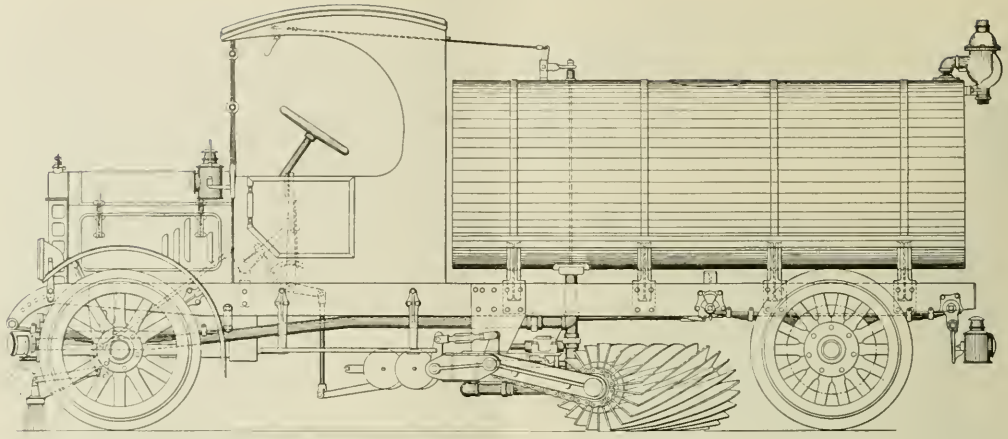
This machine can be run so as to cut very close to a finished fine grade, saving a considerable amount of expensive hand work. In practice, it is found best to make the outside cuts on street work first, cutting to a line to allow room for the curb and gutter and the forms. On the outside cuts the excavator is pitched to conform to the crown of the street. If the width of the excavation should be 25½ feet, there would be two outside cuts, one cut in the center with nothing left, and the third and middle cut made flat. If the width of the excavation was less than 25½ feet, the result would be the same.

If the width of the excavation was 27½ feet, for instance, there would apparently be 2 feet of the side which could not be handled thru the machine. However, this extra material is taken care of by making the center cut as before, and sufficiently deep so that the one foot of surplus material on each side of this cut, can be leveled down and rolled into the center cut.



In practice it has been found desirable to cut slightly below the finished subgrade and at the last cut to finish the fine grade at once, by dumping sufficient material from the wagons to level it up to the desired grade and roll at once. Obviously, this is much less work than making a fine grade by removing surface by hand tools.

Material at alley intersections is taken care of by excavating deeper in front of the intersection for 16 to 24 feet, thereafter to plow the intersection and slip the earth into the extra depth. This machine will work on old macadam streets if the excavation can be made two inches. It is seldom necessary to root or ploy the streets in advance of the machine, as the cutting drum is provided with narrow sharp cutting teeth. This machine will also handle sand as well as fine material.



In street railway track excavation, the track trench is usually 18 to 20 inches deep and 8½ feet wide. This cut is made in one operation and the spoil put in wagons. If it is railway track work, the track may be removed closely ahead of the machine by jacks, and the trench being completed, new track can be laid directly in back of the machine, so that in case of single track work, the cars can be kept running with only a break and transfer of 150 to 200 feet. About 500 linear feet of track trench can be handled per day of ten hours.

These machines have been run on work, both paving and street railway, in Illinois in 1914 and 1915, and have proved satisfactory and practical in every case.

Sterling-Kindling Motor Squeegee

The Kindling Machinery Company, Milwaukee, are marketing a motor-driven outfit as described in the March issue of MUNICIPAL ENGINEERING.

The Kindling rubber rotary squeegee, of familiar use on horse-drawn tank wagons, is shown by the accompanying cut combined with a Sterling chassis carrying a 1,000-gallon tank. The essential features of the motor squeegee are described as follows:

Placed immediately in front of the front fenders of the chassis are two flusher nozzles controlled by the driver by a lever from his seat. The flusher nozzles, by sprinkling the surface of the street, prevent the agitation of dust, and also dampen the attached matter, so that the squeegee roller can easily force it loose from the pavement and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted immediately behind the front nozzles, the purpose of which is to force aside the large refuse so that it will become suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the center of the chassis frame and immediately underneath is a squeegee or spiral-shaped roller of 19 inches diameter and 8 feet long. Each individual, specially-treated rubber spiral is firmly set, but easily detachable, and mounted in a special kiln-dried wood holder of large wearing surface. And, being adjustable as they wear, more fresh surface of the squeegee can be brought into engagement with the street. The squeegee attachment is flexibly mounted and counterbalanced in such a way that when adjusted to a certain pressure it is impossible for the roller to work loose and the pressure against the surface of the street is uniform, the rubber strips being 6 inches deep, affording large wearing surface. A toggle-joint linkage, terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street, and, when returning from washing a section of street, to lift the roller out of contact with the pavement.

The tank is fitted with a water meter which indicates the amount of water flowing thru it. The water meter serves not only as a safeguard against the squeegee operator's idling and claiming to have squeegeed more street surface than he has, but gives data for calculating the water consumption per square yard for different kinds of pavements, under different conditions, etc. The tank contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.

The manufacturers of the motor squeegee described are the Sterling Motor Truck Company, Milwaukee, Wis.

Use of Automatic Buckets

Figs. 1 and 2 illustrate two Hayward buckets as used in public construction.

Fig. 1 bucket is in operation on the southern outfall sewer, Louisville, Ky. Work done by the Blackstaff Engineering Company. The section upon which this picture was taken is

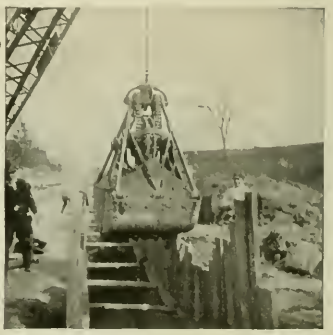


FIG. 1. SEWER TRENCHES MAY BE EXCAVATED WITH HAYWARD BUCKETS AND THE MATERIAL LOADED DIRECTLY INTO WAGONS, WITHOUT THE AID OF A HOPPER. THE ILLUSTRATION SHOWS A TRAVELING DERRICK OPERATING IN THIS WAY.

FIG. 2. HAYWARD BUCKETS ON SEWER WORK. WITH THE TRENCH MEASURING 6 FEET WIDE AND THE SPACE BETWEEN AVERAGING 10 FEET, THIS 1½-CUBIC-YARD BUCKET DUG ALL GRADES OF SAND, LOAM AND GRAVEL.

about 4,000 feet long, consisting of a junction chamber connecting the 7-foot 8-inch sewer to a 12-foot sewer, a branch sewer 10 feet in diameter and 150 feet long, and a long stretch of main sewer 7 feet 8 inches and 7 feet wide. Most of the work is being carried on in open cut, the excavating being made with a Hayward orange peel bucket, operated by a traveling derrick, which is supported across the excavation in such a manner as to take up the least possible amount of street width. The depth of cut varies from 25 to 28 feet.

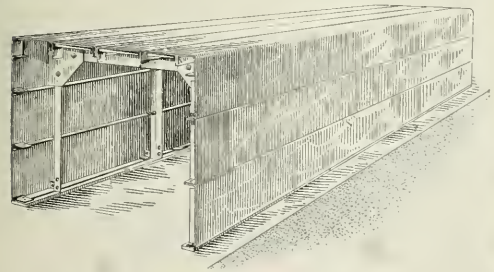
The location is in the center of a street paved with brick, in a part of the city well built up, mostly in the residence district. The upper 10 or 12 feet of earth is clay or loam, beneath which is coarse sand, with some gravel in it, the combination presenting great difficulties in properly sheeting and bracing so as to avoid damage to the street and surrounding buildings.

Fig. 2 shows bucket operating on a 48-inch city water main, Bay Ridge, boro of Brooklyn, N. Y. F. V. Smith Contracting Company. Trench, 6 feet across; bucket, 1½ cubic yards; Class H clam shell, with ore bowl, fitted with teeth; operated by a Brown hoist crane. Spacing between struts, about 10 to 12 feet; average depth of cut, 10 feet. Material, all grades of sand, loam and gravel.

Adjustable Rectangular Culvert Form

We are illustrating a popular type of Blaw adjustable rectangular culvert form.

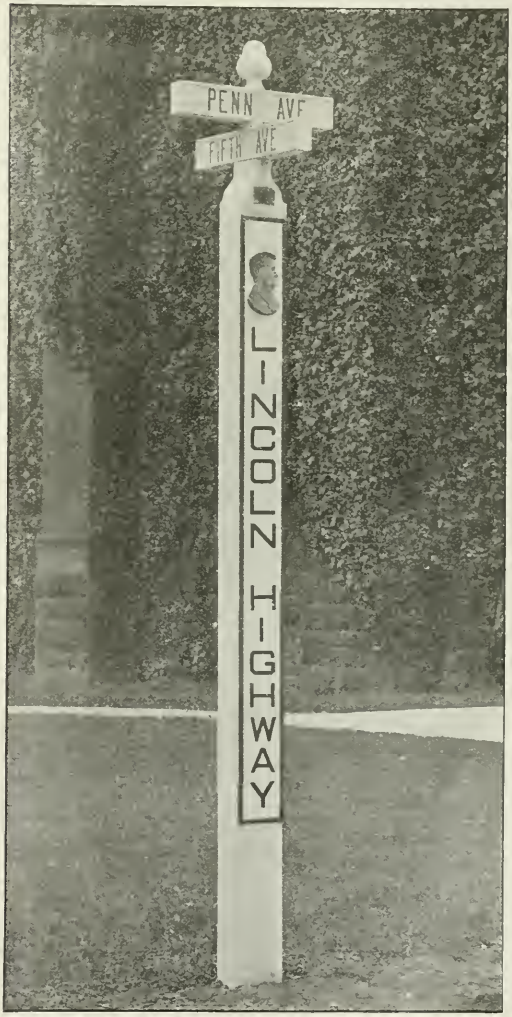
The sections are in 5 and 10-foot lengths, made up in sets adjustable from 2-foot height by 3-foot width up to 5-foot height by 6-foot width, with any 12-inch adjustment. They are composed of plates 12 inches high and 12 by 12-inch bracketed corners, with brace angles in the interior, which support the sides and roof. A small number of hook bolts are used to connect the roof panels and the side panels to the supporting interior angles thru the outstanding flanges of the panels themselves. They draw the entire form together, are very easily inserted in place, and are a permanent part of the interior supporting angles.



Concrete for the base or floor of the culvert is first placed. Boards 1 inch by 4 inches are then laid along the sides of the base. The mold is put in position on top of these boards. After the concrete has set, the board is withdrawn, being easily slipped out from under the form. The hook bolts are turned around and released, the roof is removed all in one piece, and each complete side piece is removed.

Reinforced Concrete Posts

The introduction of concrete into all lines of construction work has given rise to numerous specialties, covering many fields of operation. An original and practical use has been ap-



plied to concrete in the manufacturing of National reinforced concrete-lettered signs and posts. These products are made from white, stainless portland cement and crushed granite, molded by a special process, which produces a hard, smooth surface, unstainable and permanently unaffected by weather conditions. The letters are molded in a plastic state and dovetailed into the body of the concrete, making the whole work a monolithic structure.

In the accompanying illustration there is shown a combination lamp post and street marker which has been installed in the city of Pittsburg, where it serves to designate the Lincoln Highway. This post is made of concrete and has a 6-inch face and 5-inch side; the total height from ground level to the bottom of the first sign is 8 feet; the post is set 3 feet in the ground. Connections have been provided for future use, both for gas and electric light.

Both the letters and the bas-relief of Lincoln on the face of the post are blue on a white ground. The post is faced with a portland cement mixture, and the inlay letters are tinted to produce the desired color effect. The border, shown as a black line on the illustration, is a concrete mixture colored red. The letters of the street signs are black.

These products are made by the National Concrete Sign and Post Company, Inc., Oil City, Pa.

Concrete Street Signs

W. H. Filer, Grove City, Pa., manufacturer of artistic concrete products, offers a very novel specialty in guide posts, consisting of a reinforced concrete standard, with concrete boards, as shown in cut.

The posts are ornamental in design, having beveled edges and sunken panels. The concrete inscription boards are neatly made, and letters are of cement, in black and other colors, $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness, dovetailed in the body of the work, and as they are non-fading, the signs are indestructible and everlasting.

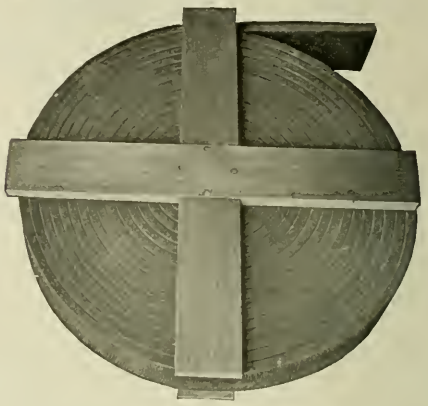
CONCRETE SIGN AND STANDARD.

These posts and signs are made of granite and Medusa white portland cement, and photographs cannot emphasize the beauty and clearness of the product. Mr. Filer states that "the best material adapted for this work that I can find is Medusa white portland cement."

A New Expansion Joint, Made by the "Fiber Weld" Process

A new material for the expansion joints of concrete, brick or block pavements is now being offered by The Barrett Company.

It is a mastic which comes ready to lay, in ribbon form, in a variety of widths and thicknesses. It contains no felt or paper reinforcement.



"BARRETT'S NEW FIBER-WELD-PROCESS EXPANSION JOINT"

A new process, known as the "Fiber Weld" process, gives to the bituminous mastic the requisite cohesiveness to stand handling and storage in the ribbon form, without affecting the elasticity that is necessary for expansion requirements.

It seems to possess all the elasticity of a poured bituminous joint with all the advantages of easy handling.

The material is waterproof and weatherproof and is not injured by street acids or automobile oils. It does not become brittle with age or cold weather and does not soften or run in hot weather.

Its chief advantage over the usual poured bituminous joint is the elimination of heating or pouring apparatus and a great reduction of the labor item—as it takes only a moment to unroll the joint and cut and put it in place.

It will be marketed under the name of "Barrett's Expansion Joint."

The Road Builder's Guide

A complete guide for the road builder to grading, rock-crushing and road surfacing equipment is issued by the Austin-Western Road Machinery Co., of Chicago. One of the companies to which the present corporation is the successor was the Western Wheeled Scraper Co., which, in its wheeled scraper entered the market with the first piece of improved machinery. Since that time that company and the Austin Mfg. Co., and their successor, the present company, have been in the forefront of the development of road machinery and the publication referred to shows the results of their exterprise and it is what it purports to be a complete guide to modern road building apparatus, including road graders and reversible road machines of various designs to suit any kind of work

Forest Lawn Road, Florence, Neb., showing condition of road before the use of "Tarvia-X"

Before and after——

BEFORE this road was tarviated it was difficult to keep the surface in decent condition on account of the automobile traffic. The swift thrust of automobile driving wheels disintegrated the surface and the expense of maintaining the road in good repair was large.

When it was resurfaced in June, 1915, the road was bonded with "Tarvia-X".

The Tarvia forms a tough, plastic matrix about the stone, cementing it into a concrete. Automobile wheels instead of destroying the surface will compact it and help to preserve it.

Tarvia
Preserves Roads
Prevents Dust

The use of the Tarvia added a little to the cost of the resurfacing of the road, but this will soon be repaid in the *reduced cost of maintenance.* This road service is waterproof and develops no dust or mud.

Scores of communities now are using Tarvia regularly year after year simply for the sake of keeping down road expenses. There are three kinds of Tarvia and a dozen ways of using them to meet various road problems.

Booklets on request. Address our nearest office.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis
Cleveland Cincinnati Pittsburgh Detroit Birmingham
Kansas City Minneapolis Salt Lake City Seattle Peoria

The Paterson Manufacturing Co., Limited: Montreal Toronto
Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

Forest Lawn Road, showing transformation of road surface after the use of "Tarvia-X"

required, road rippers, scarifiers, road planers and finishers, portable rock crushers, portable rock screens and bins, conveyors, motor road rollers, elevating graders, dump wagons, stone-spreading wagons, street sweepers, combined sprinklers and sweepers, street sprinklers, pressure road oilers, horse rollers, dump cars, road drags, wheel and drag scrapers and plows, all of which are fully described and their uses illustrated. The book also describes a motor lawn mower which looks interesting.

Any grade of machinery needed for any kind of road work can be selected from the full information given. The book will be sent on request.

Trade Notes

Cleveland Tile Hook Co., Cleveland, O., have a hook for handling building and conduit tiles which should be very popular.

Two 360-b.h.p. 4-cylinder oil engines have been installed by the Bolinders Company, of Stockholm and New York, for the Watson Flagg Engineering Co., Perth Amboy, N. J., where they run direct-connected to General Electric Co.'s 60-cycle alternators in parallel by means of Bolinder's special synchronizing device.

"Saving Cents and Losing Dollars" is the title of a little circular of the Studebaker Corporation, South Bend, Ind., on dump wagons.

The Coldwell combination roller and motor lawn-mower seems to meet the large demands for the work it can do to the full satisfaction of their users in parks, golf clubs and private grounds in all parts of the country.

The National Motion Pictures Co., Indianapolis, Ind., have produced, in collaboration with the National Fire Protection Association of Boston, a moving picture film about 1,000 feet long, showing various methods in which fires start and the results of carelessness and neglect of regulations.

The Indiana Paving Brick & Block Company, Brazil, Ind., is the latest addition to the family of licensees of the Dunn Wire-Cut Lug Brick Company. The Indiana company has been in business for many years and has a high standing in the paving brick industry. The plant has a daily capacity of about 50,000 pavers and it is equipped with twenty-six kilns, 30 feet in diameter.

The corporate title of The Sandusky Portland Cement Company, Cleveland, Ohio, has recently been changed to that of "The Sandusky Cement Company," the officers and directors in the new company being the same as those of the old concern. There will be no other changes of any kind whatever, the business of the company being carried on as formerly, but the trade is requested to make special note of the new title and make use of the same in all correspondence.

The Keyport Engineering Co. has just placed a contract with the John W. Ferguson Co., of New York and Paterson, N. J., for a new factory building at the corner of Chansler avenue and Coyt street, Irvington, N. J. The building will consist of one story, 80 feet by 100 feet with brick walls and a sawtooth roof over half its length.

The Pittsburg-Des Moines Co., Pittsburg, Pa., have leased the Neville Island plant and taken over the business of the Pittsburg branch of the Des Moines Bridge and Iron Works, a change in name but not in management, and the business will be conducted as heretofore.

The Atlantic Vehicle Co., Newark, N. J., published, in the form of diagrams, the results of the investigation made at the Massachusetts Institute of Technology into the cost of hauling by horse, gasoline and electric storage battery, which shows the greater economy of the latter.

The Kochring Machine Co., of Milwaukee, Wis., have moved their headquarters in Portland, Ore., to 254 East Hawthorne avenue., and at Seattle, Wash., to 1208 Western avenue. At each place is a spacious warehouse with a complete stock of Kochring mixers and parts, ready for immediate delivery. They are also distributers for the Northwest of the Sterling motor truck and the C. H. & E. saw rigs and pumps and carry complete stocks of each at these warehouses.

Pump for Testing Water Mains and to Supply Concrete Mixers

One of the designs of the Atlantic pumping engine, sold by Harold L. Bond Company, 383 Atlantic avenue, Boston, Mass., is fitted for testing water mains under pressure, providing an inexpensive, portable, dependable method for making construction tests, which will give the contractor protection and the engineer satisfaction. It is a 3½-h.p. gasoline engine with 5-inch bore, 6-inch stroke and speed of 350 to 550 r.p.m., connected by direct cut gear to double-acting 2½-inch bore, high-pressure pump, together with Pyramid 5 by 5 double-acting pump connected up to engine shaft with Whitney roller chains and machine-cut sprockets, enclosed in dust-tight housings. A relief valve on the discharge of the large pump discharges when the main is full of water and the handle of the 3-way cock at suction of large pump is turned, cutting off the water from the large pump and leaving only the small pump in operation. This reduces the load on the engine and allows the pressure to be carried up to any point desired by means of the small pump. A check valve in the discharge of the large pump keeps the water at high pressure from thelow-pressure reliev valve. The gage and relief valve can be set for any desired duty up to 300 pounds. The capacity of the two pumps together at 90 pounds pressure is 2,880 gallons an hour.

One important use for these pumps is to supply water to boilers for operating concrete mixers and other construction plants and for the concrete when it must be piped for some distance thru temporary lines.

Florida's Brick Roads

Florida these days is "eating brick." The building of brick roads has been given a strong impetus during the past year by the introduction of new constructional methods which make for durability. In Volusia county recently a contract was let to the Southern Clay Manufacturing Company, of Chattanooga, Tenn., for 200,000 yards of 3½-inch wire-cut-lug brick pavement, in the Deland-Lake Helen district, the brick to be laid on edge on a natural soil foundation and grouted. This road will be about 26 miles long, and 9 feet wide, except in Deland. In the latter place, the roadway will be paved 50 feet wide. Many miles of this type of road were constructed in Orange county in 1915, and a large amount of yardage will be built in other sections during the current calendar year.

Portable Steel Building

Kahn portable steel buildings are completely illustrated and described in a new catalog. The whole idea of these portable buildings has been developed along new and original lines. They are substantial buildings of exceptional quality, not to be compared with the ordinary, flimsy, light-gage materials that have often been sold for portable buildings.

The field of usefulness of Kahn portable buildings is practically unlimited, covering the range from the smallest garage to large general shops for manufacturing purposes, and including contractors' houses, hospital buildings, school houses, factory buildings of all types, summer cottages, boat houses, election booths, etc.

A STANDARD OF EXCELLENCE

in any field is decided and set by the consensus of opinion among the buyers—not the sellers.

IN THE PAVING FIELD

ask the cities who are using it what they think about

BITULITHIC

The greatest care is used in the construction of the **Bitulithic** pavement. It renders unfailing service. **Bitulithic** is make of varying sizes of the best stone obtainable, combined with bituminous cement and laid under close laboratory supervision. You must remember that quality should be first consideration. The condition of the streets indicate the character of the city.

Portland, Oregon. **Bitulithic** Pavement, W. Park Street. Laid over old Macadam, 1913. Photograph taken May, 1915.

STOP AND CONSIDER

Bitulithic before determining to use inferior street paving. It is cheaper to have a good pavement in the beginning than to contract for cheap construction which has to be repaired every year.

NO TIME LIKE THE PRESENT

to consider what construction you are going to use on your streets. Specify **Bitulithic** and have a pavement which is unequalled in reputation—unquestioned in quality—unrivalled in popularity.

Don't wait—get your contracts in early for **Bitulithic,** a pavement suitable under all the varying climatic conditions.

Write today for explanatory booklets and learn more about this modern pavement for modern cities.

Warren Brothers Company

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Contracting News

AUTOMOBILES, FIRE APPARATUS AND MOTOR EQUIPMENT.

Ambler, Pa.—Appropriation recommended by Boro Council for purchase of motor fire apparatus. Amount of appropriation $7,000. Address Boro Council.

Butler, N. J.—Purchase of light delivery truck favored by Councilmen. Jesse Ward, Mayor.

Dyersburg, Tenn.—Bids will be received for furnishing 500 or 1,000 ft. 2½-in. hose. S. R. Blakeman, Supt. Water & Light Dept.

Donaldsonville, La.—Motor driven combination chemical and hose car will be purchased.

Elizabeth, N. J.—City may soon be in the market for purchase of 6 tractors, 2 motor combination cars and 2 pumpers. Council may take action at meeting May 4. August Gerstung, Fire Chief. R. L. Patterson, Pres. Bd. of Commrs.

Ellsworth, Me.—Appropriations of $700 and $3,000 voted for purchase of fire hose and other fire equipment.

Ford City, Pa.—May 8 until 8 p. m., for furnishing fire apparatus. D. C. Crouch, Boro Secy.

Grand Rapids, Mich.—Purchase of 5 new tractors and 1 gas pumper included in budget for police and fire departments. Geo. Boughner, Fire Marshal.

Granger, Tex.—Motor fire apparatus and other equipment will probably be purchased. S. D. Davis, Mayor.

Havana, Cuba.—Bids are now being asked for motor driven apparatus including motor pumping engines, 85-ft. aerial ladder truck, city service truck, squad wagon, auxiliary truck, water tower and other equipment.

Kokomo, Ind.—Motor apparatus will be purchased for Stations Nos. 2 and 3.

Mayfield, Ky.—Specifications, etc., are desired on motor combination chemical and hose wagon. Address Dell Dowdy, Chief.

Naperville, Ill.—May 8 until 8 p. m., bids will be received for motor driven fire truck, capacity to carry 500 to 700 ft. fire hose and 4 to 8 men; chemical tank at least 25 gals. capacity; chemical hose 150-ft. ¾-in. rubber with brass couplings attached; nozzle; 2 acid receptacles; 1 18-ft. solid side extension ladder; 2½-gal. Babcock extinguisher. Bidders to specify in detail equipment. Otto H. Reiche, Fire Marshal.

New Brunswick, N. J.—Bids to be advertised at once for motor driven chemical and hose wagon and for two chassis for motorizing hose wagons for Engine Cos. Nos. 3 and 4. Motor driven garbage wagon also ordered purchased. Address Director of Public Safety.

Pineville, Ky.—Bids are asked on 500 ft. of 2½-in. fire hose. Samples and prices, both cash and terms desired. Address W. L. Moss, Mayor.

Plymouth, Mass.—Appropriation of $16,750 made for purchase of fire equipment. A. S. Burns, Mayor.

Portland, Ore.—Until May 22 for one tractor and one motor combination chemical and hose car. J. R. Wood, City Purchasing Agent.

Salt Lake City, Utah.—New car, probably of touring type will be purchased for police department. Address Police Commrs.

Scituate, Mass.—Bids are asked for supply of 500 ft. of 2½-in. fire hose. Mail estimates to P. O. Box 105, Scituate, Mass. E. E. Seavems, Fire Chief.

Somerville, N. Y.—Resolution passed for bond issue of $1,000 for purchase of motor combination chemical and hose wagon for West End Hose Company. Address Boro Council.

Superior, Nebr.—Purchase of combination chemical and hose motor truck authorized. Address City Council.

Waterford, N. Y.—Purchase of motor combination chemical and hose wagon at about $2,900 contemplated.

Waynesboro, Pa.—City service truck will be purchased for Hook and Ladder Co. to replace horse drawn truck now in use. Address Boro Council.

West Chester, Pa.—Purchase of motor combination chemical and hose truck planned by Kennett Fire Company. Probable cost $6,000.

BRIDGES.

BIDS REQUESTED.

Brazil, Ind.—May. 16 until 10:30 a. m., for bridge construction in Sugar Ridge Twp., Clay Co. Wm. O. Graeser, Co. Aud.

Columbus, Ohio.—May 12 until noon, for two concrete culverts in Marion and Jackson Twps., Franklin County. c. c. $100. John Scott, Clerk, Bd. of County Commrs.

Cumberland, Md.—Until June 5, for two reinforced concrete bridges over Willis creek, one at Baltimore St. and one at Valley St. B. H. Davis, Consult. Engr., Whitehall Bldg., N. Y.

Kearney, Nebr.—May 23 until 10 a. m., for bridge across Platte River, near this city. Plans call for one steel truss bridge composed of ten 100-ft. low truss spans, and wood piles and for one concrete arch bridge composed of 14 spans, on wood piling. c. c. $5,000. J. H. Dean, Clk. Buffalo Co.

Los Angeles, Cal.—Until May 8, for reinforced concrete viaduct 242 ft. long and 20 ft. wide, over ravine, Pacific Electric R. R. tracks and Ionia Ave. at Western Ave. A. M. McPherrin, Clk. Bd. of Supvrs.

Manhattan, Kans.—May 16 until noon, for construction of two bridges and repair of one bridge over Blue River, between Riley and Pottawatomie Counties. c. c. $200 required with each bid. Geo. H. Hungerford, Co. Clk.

Medora, Ill.—May 10 until 11 p. m., for reinforced concrete bridge work in Ruyle Twp., Jersey County. Chas. R. Warren, Co. Supt. Highways, Jerseyville, Ill.

Polo, Ill.—May 8 until 2 p. m., for reinforced concrete bridge work in Pine Creek Twp., Ogle County. Alex. Anderson, Co. Supt. Highways, Polo, Ill.

Springfield, Ill.—May 10 until 11 a. m., for three reinforced concrete bridges in Knox County, State Aid work, on Routes No. 8 and No. 11-0, known as Section "A." Address State Highway Dept.

CONTRACTS AWARDED.

Concordia, Kans.—To Western Bridge Co., Harrisonville, Mo., construction of 12 bridges in county at $19,468.

Galveston, Tex.—To Wm. Moore, Texas City, temporary vehicle bridge between island and mainland at $11,561.16.

Marshalltown, Ia.—To Thor Constr. Co., Cedar Falls, Ia., 48 reinforced concrete bridges and culverts at $43,428.

Rockford, Ill.—To Hackedorn Constr. Co., Indianapolis, Ind., reinforced concrete bridge at Chestnut-Walnut Sts., at $81,000.

Rock Island, Ill.—To the Gould Constr. Co., Davenport, Ia., Colona bridge between Henry and Rock Island Counties at $59,300.

Sacramento, Cal.—The Mercer-Fraser Co., Eureka, Cal., submitted lowest bid for steel truss bridge with reinforced concrete approaches, over Eel River in Humboldt County. Bid $102,825.

St. Louis, Mo.—To Miller-Borcherding Steel Bridge Co., St. Louis, Valley Park steel bridge over Meramec River at $46,000.

Vinton, Ia.—To Koss Constr. Co., Des Moines, 4 bridges and 8 culverts at $10,096; to James Park & Co., 4 bridges and 2 culverts at $7,059; to Waterloo Constr. Co., Waterloo, 3 steel bridges at $12,601. All work to be constructed by Benton County.

CONTEMPLATED WORK.

Alpena, Mich.—New bridge to replace 9th bridge being planned. Estimated cost $15,000. Jos. W. McNeil, City Engr.

Bemidji, Minn.—Bond issue of $6,000 for construction of steel bridge over Mississippi River in Frohn Twp. voted recently. Address County Comrs.

Chicknsha, Okla.—Construction of concrete bridge over Line Creek, at intersection of 4th and Frisco Sts. planned. Address O. Coffman, Mayor.

Clarksville, Tenn.—Bonds amounting to about $200,000 for constructing bridge across Cumberland River at Clarksville, will be voted on shortly. W. T. Young, Engr., Nashville. C. W. Tyler, County Judge.

Conshohocken, Pa.—Construction of two bridges over Schuykill River, one at this place and one at Royersford planned by County Commrs. Estimated cost of Conshohocken bridge $250,000. Address Commrs. of Montgomery County for further information.

Galion, Ohio.—Surveys being made for 100-ft. span bridge. H. A. Keller, Engr. H. A. Beidighauser, Aud. Crawford Co.

Minneapolis, Minn.—Plans prepared for ornamental concrete bridge across West Lake St. Estimated cost $100,000. F. W. Cappelen, City Engr.

Moscow, Ida.—Plans being prepared for concrete bridge at foot of 6th St. Will be ready in about one week for submission to city council for approval. Harvey Smith, City Engr.

Perry, N. Y.—Bond issue of $11,000 for construction of concrete bridge at Borden Ave. will be voted on soon. Geo. M. C. Parker, Member of Town Board.

Peru, Ind.—$25,600 appropriation for new bridges to be constructed over Deer Creek in Miami County. Address Co. Commrs.

Pullman, Wash.—Construction of viaduct 1,000 ft. long to connect Main St. with its continuation in College Park proposed.

BUILDINGS.

BIDS REQUESTED.

Ebensburg, Pa.—Until May 17, for 2-story brick hollow tile school bldg. Walter R. Myton, Archt., 1204 1st Nat'l. Bank. Bldg., Johnstown, Pa. A. J. Appel, Secy. School Board.

Fertile, Ia.—Until May 10, for erecting consolidated school bldg. Separate bids for heating and plumbing. Thornwald Thorson, Archt., Forest City, Ia.

Osgood, Ind.—May 10 until 10 a. m., for brick school bldg. for Jackson Twp., Ripley County. W. C. Snider, Twp. Trustee.

Tiosa, Ind.—May 12 until 2 p. m., for school bldg., for Richland Twp., Fulton County. Wm. Foster, Twp. Trustee.

Washington, Warren Co., N. J.—May 15 until 7:15 p. m. for alterations and additions to Public school bldg. in Boro. c. c. 1% of bid. L. M. Shrope, Dist. Clerk.

CONTRACTS AWARDED.

Billings, Mont.—To V. W. Eames, Billings, addition to Broadwater school, brick and concrete construction at $18,000.

Boise, Ia.—To Geo. Bronson, New Meadows, construction of Adams County courthouse at $14,500.

Decatur, Ind.—To Mann & Christen, Decatur, Ind., two-story brick school bldg. to be erected near Farmland, at about $25,000.

Pleasantville, Ind.—To Chas. B. Willis, Carlisle, Ind., Jefferson Twp. high school bldg. at $18,000.

St. Paul, Minn.—To C. Ash & Sons, city, addition to city hospital at $34,336.

Winchester, Ind.—To Mann & Christen, Decatur, Ind., general construction of brick school bldg. for Stoney Creek Twp., at $21,438. Heating and ventilating contract awarded Johnson & Son, Indianapolis, Ind., at $1,865. Plumbing contract to Hobbick & Co., Winchester, at $1,575.

CONTEMPLATED WORK.

Birmingham, Ala.—Bond issue of $2,000,000 for new school bldgs. and repair of old bldgs. will be voted on June 5. Address Bd. of Educ.

Bridgeton, Ind.—Bids will be called soon for high school bldg. to cost between $13,000 and $15,000. Johnson & Miller, Archts., Terre Haute, Ind.

Chisholm, Me.—Brick grammar school bldg. to cost about $25,000 planned. Address Chrmn. Bldg. Comm., Bd. of Educ.

Drumright, Okla.—Plans being prepared for 2-story school bldg. Estimated cost $50,000. C. E. Hair & Co., Archts., 417 Terminal Bldg., Oklahoma Cit.

Farmersburg, Ind.—Erection of school bldg. by this city and Curry Twp. being urged. Probable cost $14,000.

Jacksonville, Ala.—Bond issue of $10,000 voted for construction of new school bldg. Address Bd. of Educ.

Marlin, Tex.—Brick high school bldg., costing $50,000 may be erected this year. A. T. Goode, Secy. School Bd.

McAlester, Okla.—Bond issue of $75,000 voted recently for additions to school bldgs. Address Bd. of Educ.

The Kingdom of the Subscriber

In the development of the telephone system, the subscriber is the dominant factor. His ever-growing requirements inspire invention, lead to endless scientific research, and make necessary vast improvements and extensions.

Neither brains nor money are spared to build up the telephone plant, to amplify the subscriber's power to the limit.

In the Bell System you have the most complete mechanism in the world for communication. It is animated by the broadest spirit of service, and you dominate and control it in the double capacity of the caller and the called. The telephone cannot think and talk for you, but it carries your thought where you will. It is yours to use.

Without the co-operation of the subscriber, all that has been done to perfect the system is useless and proper service cannot be given. For example, even though tens of millions were spent to build the Transcontinental Line, it is silent if the man at the other end fails to answer.

The telephone is essentially democratic; it carries the voice of the child and the grown-up with equal speed and directness. And because each subscriber is a dominant factor in the Bell System, Bell Service is the most democratic that could be provided for the American people.

It is not only the implement of the individual, but it fulfills the needs of all the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Contracting News

Sultan, Wash.—Bond issue of $18,000 voted for school bldg. Address Bd. of Educ.

Twin Falls, Ida.—Plans being prepared for new school bldg. to cost about $40,000. G. E. Bryant, Clk. of School Bd. Burton E. Morse, Archt., Twin Falls.

GARBAGE DISPOSAL.

CONTRACTS AWARDED.

Bennetsville, S. C.—To Nye Odorless Crematory Co., Macon, Ga., construction of crematory plant at about $2,500.

Madison, Wis.—To W. J. Edwards & Co., Chicago, Ill., installation of 20-ton Decarie garbage incinerator plant, single type at $23,500.

LIGHTING.

Birmingham, Ala.—Bond issue of $500,000 for municipal light plant will be voted on June 5. James Weatherly, Commr. Pub. Utilities.

Blackwell, Okla.—Bonds amounting to $10,000 voted April 19 for electric light extensions. Bonds sold. The Benham Engr. Co., Consult. Engrs., Oklahoma City, Okla.

Clark, S. D.—Installation of electric lighting plant is being considered. System may be installed this summer. Address City Council.

Columbia City, Ind.—Contract awarded Crocker & Wheeler, Indianapolis, Ind., for generator and electrical equipments for municipal light plant, at $5,553; to General Fire Extinguishing Co., Warren, Ohio, piping and valves, at $5,700.

East Aurora, Ill.—Installation of new street lighting system being considered. Election will be called in near future. Estimated cost $5,500. Mr. Brotherhood, Mayor.

Peoria, Ill.—Installation of ornamental lighting system on Perry Ave being planned. L. D. Jeffries, City Engr.

Portland, Ore.—Investigations show that municipal street lighting plant, to light streets, municipal bldgs. and parks, can be installed for $2,000,000. Survey not completed until fall. Project involves flume about seven miles in length to operate hydro-electric plant and installation of power lines to city. Mr. Daly, Commr.

Richmond, Ind.—Installation of ornamental street lighting system being planned. System proposed will probably provide for four to six lights in each block. Fred Charles, City Engr.

Zeeland, Mich.—Contract awarded Von Hage & Kraal, Zeeland, for furnishing boulevard lighting posts.

PARKS.

Indianapolis, Ind.—To C. S. Darlington, Chicago, Ill., contract for installation of electric fountain in Garfield Park Gardens at $6,750.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Angola, Ind.—May 9 until 1:30 p. m., for about 20,000 sq. yds. pavement on North Wayne St. C. F. Powers, City Engr.

Bexley, Ohio.—May 8 until noon, for grading, curbing and paving with brick Drexel Ave., from Denver Ave. to Maryland Ave. c. c. $500. Chester A. Miller, Village Clerk.

Brazil, Ind.—May 16, until 10:30 a. m., for grading, draining and paving with brick Benj. Kester road in Brazil Twp. Clay Co. Wm. O. Gruesser, Co. Aud.

Byron, Ill.—May 12 until noon, for 9 miles macadam roads, requiring 15,120 cu. yds. material Alex. Anderson, Supt. of Highways, Polo, Ill.

Grinnell, Iowa.—May 10 until 7 p. m., for 17,000 ft. curb and gutter and 24,000 sq. yds. bitulithic, brick or asphalt paving, c. c. $2,000 required on Grinnell Bank made payable to Scott MacEachron, Treas. A. C. Harriman, City Clerk. Iowa Engr. Co., Consult. Engrs., Clinton, Iowa.

Keyport, N. J.—May 8 until 8 p. m., for about 12,000 so. yds. reinforced concrete pavement on Broad St. c. c. $1,000. R. O. Walling, Mayor.

Lebanon, Pa.—May 12 until 5 p. m., for following pavements: 9th St., 3,500 sq. yds., Lehman St., 2,900 sq. yds., 8th St., 3,900 sq. yds., 7th St., 7,800 sq. yds., 7th St., 4,900 sq. yds. Bids to be received on wood block, vitr. brick, Amiesite, Warrenite or Topeka on 5-in. concrete base. c. c. 5% of bid Paul L. Volcker, City Engr.

Mandan, N. D.—May 15 until 1 p. m., for grading and terracing Court House Hill. c. c. 5% of bid. Lee Nichols, Co. Aud.

Mandan, N. D.—May 15 until 1 p. m., for concrete walks, steps and retaining wall at Court House. c. c. 5% of bid. Lee Nichols, Co. Aud.

Marshalltown, Ia.—Until May 8, for 63,000 sq. yds concrete pavement on four streets, including 2,500 lin. ft. curb. W. H. Steiner, City Engr.

Seattle, Wash.—May 8 until 11 a. m., for constructing Mercer Island Road. c. c. 5% of bid. Byron Phelps, Clk. Bd. of King Co. Commrs.

South Bend, Ind.—May 16 until 10 a. m., for 71,500 sq. yds pavement on Eddy St. and Mishawaka Ave. Bids to be received on asphalt, asphaltic concrete, bitulithic and brick. Address Bd. of Public Works.

South Bend, Ind.—May 8 until 11 a. m., for grading, draining and paving with concrete, Hubbard road in Oliver Twp., St. Joseph Co. Arthur F. Wolf, Co. Aud.

CONTRACTS AWARDED.

Asheville, N. C.—To Fanning, Cowan & Oates, Ashville, paving various streets, bid $1.65 for asphaltic concrete and $1.81 for sheet asphalt.

Audubon, Ia.—To the National Roofing Co., Omaha, Nebr., asphaltic concrete pavement. at $83,090.

Burlington, Ia.—To Karl Hucke, Burlington, cement sidewalk construction for ensuing year at 9½c per ft.

Cincinnati, Ohio.—To Kirchner Constr. Co., Cincinnati, 9,800 sq. yds. wood block pavement on 6th St. at $36,789.

Columbus, Ohio.—To Andrews Asphalt Paving Co., Hamilton, Ohio, sheet asphalt pavement on Dennison Ave. at $38,019.50.

Davenport, Iowa.—To General Engr. & Construction Co., brick pavement on 9th St., at $4,146.37, 5th St. at $6,391.12 and 18th St., at $4,331.56.

Dixon, Ill.—To Rink & Schnell, Dixon, Franklin Grove section of Lincoln Highway at $28,335.29; to Duffy & Hubbard, Dixon, Palmyra section of Lincoln Highway at $24,697.82 and Colony route at $27,952.82.

Ellicott City, Md.—To Thomas, Bennett & Hunter, Westminster, road construction between Lisbon and Woodbine, at $20,031.

Elmira, N. Y.—To Herman Vogel, Elmira, contract for sidewalk construction during 1916.

Eveleth, Minn.—To Lawrence-McCann Co., Eveleth, 6,000 sq. yds. bitulithic pavement on Jones St., at $17,900 and 7,000 ft. curb and 300 sq. yds. sidewalk construction on Roosevelt Ave. at $10,635.

Falls City, Nebr.—To Monarch Engr. Co., Falls City, 3-in. vertical fiber brick pavement with asphalt filler at $1.89 per yd.

Galion, Ohio.—To Mustard Bros., Ada, Ohio, waterbound macadam pavement on Galion-Marion road, length 12,964 ft. at $23,950.

Goshen, Ind.—Lowest bids submitted for four kinds of pavement on South Third St. are as follows: Brick on concrete foundation, W. W. Hatch & Sons, $31,383; brick on earth foundation, same firm, bid $26,443; sheet asphalt, S. S. Saxton Co., Chicago, Ill., $28,449; asphaltic concrete, same firm, bid $27,149.

Greenwood, Ind.—To Geo. T. Miller, Greenwood and Lebanon, Ind., one mile concrete pavement and two miles curb and gutter at about $30,000.

Hartford, Mich.—To Bean & Jones, Benton Harbor, Mich., brick pavement on Center St., at $5,934.33.

Huron, S. D.—To C. H. Atkinson Paving Co., Watertown, asphaltic concrete pavement on 5-in. base, on Dakota Ave.

Indianola, Iowa.—To Lytle Constr. Co., Sioux City, three miles concrete pavement at about $80,000.

Ironton, Ohio.—To Scherer & Mountain, resurfacing 6th St. with brick at $18,033.

Milwaukee, Wis.—To Gunz, Guttknecht & Wussow, creosote block pavement on Walnut St. at $16,000; to Dean Constr. Co., bituminous concrete pavement on Harrison St. at $6,500.

Minot, N. D.—To G. Brangstveerd, Minot, cement sidewalk construction on various streets. Estimated cost $45,325.

Mt. Gilead, Ohio.—To Grohne Contracting Co., Joliet, Ill., reinforced concrete pavement on Mt. Gilead-Mt. Vernon road, at $97,293.

Moline, Ill.—To McCarthy Improvement Co., Davenport, Ia., asphalt pavement on 23rd, 17th and 11th Sts. at $43,559.02.

Nevada, Iowa.—To Ford Paving Co., Cedar Rapids, about 21,000 sq. yds. asphaltic concrete pavement, $1.59 per sq. yd.

North Chicago, Ill.—To Waukegan Improvement Co., Waukegan, Ill., reinforced concrete pavement on various streets, at $22,057.20.

Ottawa, Ill.—To F. E. Ball, Hampshire, Ill., paving of Ottawa Ave. at $32,446.75.

Pekin, Ill.—To Jansen & Zoeller, Pekin, Alton wire-cut brick pavement in McLean Prince Dist., at $1.68 per yd. or total of about $47,000.

Pueblo, Colo.—To Axton & Spratlen, Pueblo, bithulithic pavement, 2-in. thick on 5-in. concrete base, with concrete curb and gutter and storm sewers, at about $122,949.50.

Ritzville, Wash.—To the Cascade Constr. Co., Pacific Block, Seattle, Wash., 5-in. Concrete pavement on various streets at $37,770.

Sigourney, Iowa.—To Mr. McKee, Burlington, brick pavement on various streets at $1.97 per sq. yd.

Sioux City, Iowa.—The M: L: Flinn Paving Co., lowest bidder, for concrete pavement on Grace St., Park St. and Gilmar Terrace. Bids, $1.23, $1.23 and $1.30, respectively.

South Bend, Ind.—To Western Constr. Co., 27,000 sq. yds. asphaltic concrete pavement on Michigan St. at $65,383.38; to W. K. Brady Constr. Co., Chicago, Ill., 34,000 sq. yds. asphaltic concrete pavement on Indiana Ave. at $65,777.

Wabash, Ind.—To the Federal Asphalt Paving Co., Hamilton, Ohio, asphalt pavement on various streets at about $46,000.

Youngstown, Ohio.—To Schilling Constr. Co., Youngstown, brick pavement on Cairo-Hartville road in Starke Co., at $97,506.

Zanesville, Ohio.—To R. Emery & Sons, Zanesville, Ohio, 2.41 miles brick pavement, bridges and culverts on Barnsville-Hendrysburg road in Belmont County at $57,396.75.

LOWEST BIDDERS.

Everett, Wash.—For concrete pavement on highway from Silver Lake to Snohomish County line. P. G. Dunn & Co., Spokane, bid $111,802; for concrete pavement on highway from Everett to Silver Lake, Bancroft & Morgan, Everett, bid $51,411; for concrete pavement on Clwilleros-Snohomish road, Mark O'Dell, bid $59,205.

Kansas City, Mo.—For concrete pavement on 1½-mile stretch connecting Lone Jack road with Cass County line, Phillips & Winfrey, Kansas City, bid $54,496.50. For macadamizing same road, Michael Ross, Kansas City, bid $39,333.75.

Steubenville, Ohio.—For portion of Jefferson-Steubenville-Cambridge road, S. T. Frazier, Bloomingdale, bid $14,833.55.

Wooster, Ohio.—For section of Lincoln Highway in East Union Twp., Richard Shaefer Co., Findlay, O., $76,500.

CONTEMPLATED WORK.

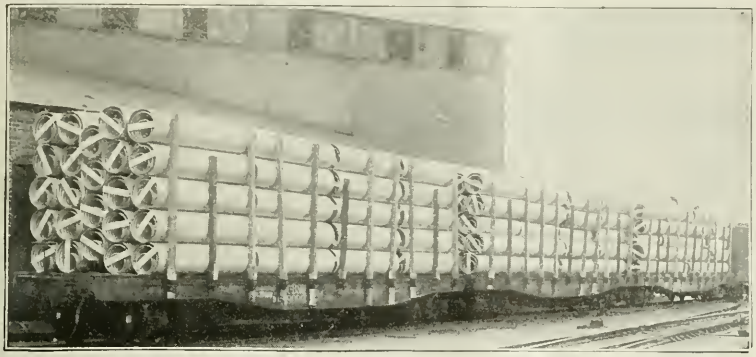
Baraboo, Wis.—Paving of Walnut, Maple and Lake streets this season with macadam finished with Tarvia X and concrete curb and gutters being planned. Mr. Thuerer, Mayor.

Belington, W. Va.—Bond issue of $130,000 for 18 miles permanent road construction in Parker District voted recently. Address Clerk, Parker District, Belington.

Boise, Idaho—Bond issue of $200,000 for road construction in Ada county will be voted shortly. Stephen Utter, Clerk Bd. of County Commrs.

Boulder, Col.—28,000 sq. yds. concrete pavement, 17,733 sq. yds. concrete sidewalks and 16,640 lin. ft. comb. curb and gutter. Geo. R. Joslyn, City Engr.

Burlington, Vt.—1,000 sq. yds. brick or clay block pavement, 125,000 sq. yds. oiled streets, 4,000 sq .yds. concrete sidewalks



Part of a recent shipment of "ARMCO" IRON CORRUGATED CULVERTS for a European Government

Purity

THE GREAT WAR has not halted the progress of highway improvment even in the countries which have millions of men on the battle line. Vast areas are even now being developed for commerce and industry by means of good roads. These are built under the direction of competent engineers who employ effective and lasting materials.

Permanence

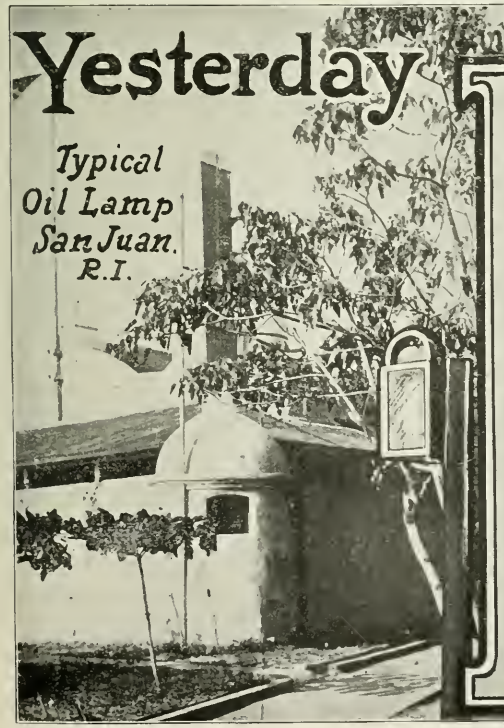
"Armco" Iron Corrugated Culverts

are chosen because of their strength, convenience and efficiency, and because they may be relied upon for long service. For full information and prices on "Armco" Iron Corrugated Culverts [full and part circle], Siphons, Flumes, Sheets, Roofing and Formed Products, write

Armco Iron Culvert Mfrs. Association

Cincinnati, Ohio.

Yesterday And To-Day



The difference between Yesterday and Today is more than number of years—it's a difference in conditions, demands, habits, thoughts, progress.

Street Lighting has kept pace with the progress of the years. In place of the feeble oil lantern and crude gas lamps of Yesterday, Today's street lighting demands

Cutter Standards

Artistic. Of Grecian classic design; simple, majestic, impressive.

Durable. Cast of the finest grade of iron; built to last for generations.

Efficient. Illuminate streets and sidewalks evenly and brightly.

Economical. Reasonably installed and maintained at very little expense.

Cutter Standard lighted streets are business builders for the merchants, an excellent tonic to civic pride and an advertisement of municipal progressiveness. *New Catalog on request. Our Engineering Department will help you.*

George Cutter Company

Main Office and Factory:
431 Notre Dame St. South Bend, Ind.

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Contracting News

and 1,000 lin. ft. concrete curbing planned. F. O. Sinclair, City Engr.

Cleveland, Tenn.—About $25,000 worth of road work will be awarded in May. Address Commrs. of Bradley County.

Duluth, Minn.—Paving of East Superior St., from 16th Ave. to 39th St. east, with Bermudez or Trinidad asphalt during coming summer petitioned. Probable cost, $70,000. Mr. Farrell, Street Commr.

Erwin, Tenn.—Bond issue of $100,000 for road construction will be voted on May 29. Address Commrs. of Unicoi County.

Houston, Tex.—Paving of Jackson St., from Texas Ave. to McKinney Ave. and Capitol Ave., from Crawford to Charters Sts., being considered. Materials—creosoted wood blocks, vertical fiber brick, bitulithic, Uvalde rock asphalt, asphaltic concrete or sheet asphalt. E. E. Sands, City Engr.

Lima, Ohio—Street paving estimates, preliminary to bond issue, include about 220,000 sq. yds. pavement on various streets. Types of pavement include brick, bitulithic or sheet asphalt, and asphalt block. Von C. Miller, Asst. City Engr.

Madison, Ind.—Resolutions adopted for paving about 17 blocks of Main St. and Walnut St. with either vitrified brick, wood block, asphalt or concrete. Contracts will be let in May. Roscoe F. Lee, City Engr.

Minot, N. D.—Plans completed for about 20 blocks paving on East Central Ave., thru Eastwood Park. Estimated cost $60,000. E. J. Thomas, City Engr.

Mishawaka, Ind.—Plans being prepared for resurfacing Lincoln Highway from West St. to Church St. Chas. Cole, City Engr.

Peoria, Ill.—Repaving of road extending from Peoria to Washington, length about 10 miles, with brick being considered. Address County Commrs.

Ringling, Okla.—Laying of cement sidewalks thruout business district being planned.

Sidney, Ohio—7,222 sq. yds. brick pavement planned. Thaelon Blake, City Engr.

Spokane, Wash.—Plans being made for paving with asphaltic concrete 3 miles of Apple Way. Estimated cost $35,000. J. W. Straek, County Engr.

Brazil, Ind.—Plans have been adopted for paving Kester road in Clay County with brick. Estimated cost $69,000. Geo. Sheehan, County Surveyor.

Tiffin, Ohio—Repaving of Washington St. with brick, creosote wood block, asphalt block, 2½ and 3 in. thick, being considered. Estimated costs $33,369.10, $51,088.88, $38,971.44 and $40,910.52. Mr. Runkle, City Engr.

Waukegan, Ill.—Paving of 10th St. jointly by Waukegan and North Chicago is being planned. Reinforced concrete pavement will probably be used. Resolutions passed for reinforced concrete pavement on Helmholz and McAllister Aves. at about $9,190.73 and $9,158.93. Address Bd. of Local Improvements.

Zeeland, Mich.—Paving of Main St. from east to west limits of city being considered. Address Commr. of Streets and Sidewalks.

SEWERS

BIDS REQUESTED.

Brooklyn, N. Y.—May 10, until 11 a. m., for installing mechanical equipment of sewage pumping station at Ave. V 10th to 11th Sts., section 3, and sanitary sewers, outlet sewers and force main in Ave. V. Certified check 5 per cent. of bid. Security required $25,000. L. H. Pounds, Boro Pres.

Newark, Del.—May 8, until noon, for about 4,000 ft. 8-in. and 10-in. terra cotta sewer, manholes, etc. Also pumping station and about 400 ft. of 4-in. wood pipe force main. Certified check $500. Samuel J. Wright, Chrmn. Sewer Comm.

River Edge, N. J.—May 8, until 8:30 p. m., for sewer construction including 213 ft. 15-in. 2,270 ft. 10-in. 12,270 ft. 8-in. pipe sewers and 65 manholes. Also for sewage disposal works of Imhoff type. Certified check $2,500 and $1,500. Albert Z. Bogert, Mayor. Chas. H. Clark, Chrmn. Sewer Comm.

CONTRACTS AWARDED.

Elmira, N. Y.—To E. W. Walsh, City, sewer construction on College Ave., Franklin St. and East Church Sts. at 95 cents per ft.

Ft. Madison, Iowa—To Stephen Schulte, Ft. Madison, 48-in. sewer on Santa Fe Ave. from Morrison Ave. to creek. Either Ferguson tile block or concrete will be used.

Lafayette, Ind.—To J. F. Hipskind, Richmond, Ind., construction of Sixth Ward sewer, reinforced concrete tile to be used. Estimated cost $80,000.

Winner, S. D.—To the Chas. H. Green Co., Spokane, Wash., construction of sewer system and sewage disposal plant at $20,871.

CONTEMPLATED WORK.

Anaconda, Mont.—Bond issue of $40,000 for sewer system will be voted on shortly.

Blackwell, Okla.—Bond issue of $18,000 for storm sewers voted April 19. Bonds sold. Contract for work will be let in May. The Benham Engr. Co., Consult. Engrs., Oklahoma City.

Boulder, Col.—750 ft. 12-in., 355 ft. 24-in., 375 ft. 33-in., 390 ft. 36-in. and 1,090 ft. 42-in. sewers (concrete) planned. Geo. R. Joslyn, City Engr.

Cambridge, Ill.—Plans being made for sanitary sewer system, to cost about $45,000. Contract may be let about May 15. H. G. Stokes, City Engr., Kewanee, Ill., engineer in charge of work.

Grand Rapids, Mich.—Special election will probably be called within next month for voting on bond issue for proposed sewage disposal plants. Estimated costs of east side and west side plants, $186,500 and $151,000, respectively. George E. Ellis, Mayor.

Indianapolis, Ind.—Plans being prepared for sewer to drain large district in Irvington. Estimated cost $25,000. B. J. T. Jeup, City Engr.

Lewistown, Mont.—About $10,000 bonds for constructing trunk sewers will be voted on in near future. W. D. Symmes, Mayor.

Lexington, Ky.—Plans being prepared for main outfall sewer from junction of three mains of city to new sewage disposal field. Bids will be asked shortly. J. White Guyn, City Engr.

Oswosso, Mich.—Plans under consideration for trunk sewer in southwestern part of city. Estimated cost $20,000. Fred Hanscom, Commr. Public Improvements.

Parker, S. D.—Municipal sewer system being considered. Bond issue $28,000. L. L. Fleeger, Mayor.

Seguin, Tex.—Bond issue of $35,000 for sewer system will be voted on May 16. Address City Council.

Sweetwater, Tex.—Sewerage system and sewage disposal plant (Imhoff) to cost $15,000 and $35,000, respectively, will be voted on May 10. H. C. Hord, Jr., City Engr.

Yorktown, Tex.—Construction of sewer system in business district planned. About 2,000 ft. 6-in. pipe required. E. F. Virleck, Chrmn. Comm. on Sewers.

WATER WORKS.

BIDS REQUESTED.

New Brunswick, N. J.—May 9, until 10 a. m., for mechanical filtration plant or 6,000,000 gals. per day capacity. Certified check $5,000. Asher Atkinson, City Engr. E. J. McLaughlin, City Clerk.

Ottawa, Kan.—Until May 15, for 350 k.w. unit (possibly two) for city power plant. Equipment will consist of new unit complete with surface condenser and auxiliaries, spray cooling equipment and complete new switchboard. Geo. S. Shaad, Consult. Engr., Lawrence, Kans. David Flinchpaugh, Commr. of Utilities.

Portland, Ore.—May 8, until 2 p. m., for furnishing 850 ⅝-in. water meters. J. R. Wood, City Purchasing Agent.

Wilmington, Del.—May 12, until 2 p. m., for 12,000,000-gal. mechanical filter plant. Certified check $5,000. Edgar M. Hoopes, Jr., Chief Engr. Bd. of Water Commrs.

Winterset, Iowa—Until May 8, for improving water works system. H. S. Ely, City Clerk. O. W. Stiles, 416 Bryant Bldg., Kansas City, Mo., engineers in charge.

CONTRACTS AWARDED.

Elmira, N. Y.—To Kerr Turbine Co., Wellsville, N. Y., complete turbine engine and centrifugal pump unit at $6,345.

Seattle, Wash.—To V. Ramaggia, Yesler Sta., Kenwood, water mains in 43rd Ave. at $25,453.

CONTEMPLATED WORK.

Baldwyn, Miss.—Bond issue of $10,000 voted for improving water works system.

Bamberg, S. C.—Bond issue of $10,000 for water works extensions will be voted on May 2.

Blackwell, Okla.—Bond issue of $32,000 for water works extensions voted at election of April 19. Contract for work will be let during May. Bonds sold. The Benham Engr. Co., Consult. Engrs., Oklahoma City.

Canby, Ore.—Bond issue of $18,000 for municipal water works system will be voted on May 10. Address City Clerk for further information.

Dighton, Kans.—Election to be held May 16 to vote bonds for proposed water works and light plant to cost $28,000. W. B. Rollins & Co., Engrs., 439 Midland Bldg., Kansas City, Mo. J. A. Radford, City Clerk.

Dover, Ohio—Plans will be prepared for 2,000,000-gal. pump and 1,500,000-gal. standpipe and 12-in. supply line. Estimated cost $75,000. Geo. E. Arnold, City Engr.

Glendive, Mont.—$65,000 bonds for constructing filtration plant will be voted May 15. C. W. Bowles, City Engr.

Kennedy, Tex.—Bond issue of $32,000 for installing water works and sewer system will be voted on May 16. Address City Commrs.

Las Cruces, N. M.—Bond issue of $13,000 voted recently for enlarging water works plant. J. W. Wineard, Clerk.

Poughkeepsie, N. Y.—Bond issue of $240,000 for installation of new water mains will be voted on April 27. Daniel W. Wilbur, Mayor.

Raymond, Wash.—Surveys now being made for extension and addition to water system, to cost about $100,000. D. Henry, City Engr.

Wheeling, W. Va.—Bond issue of $300,000 for installing water works with well system will be voted on about July 1. C. B. Cook, City Engr.

MISCELLANEOUS.

BIDS REQUESTED.

Houston, Tex.—May 10, until noon, for one electric traveling crane for wharf, 20-ton; and for 4 small traveling cranes for sewage disposal plants. Estimated costs $8,000 and $7,500. R. E. Sands, City Engr.

New York City—May 9, until 11 a. m., for installing Pitot connections, valves, stuffing boxes, etc., for controlling riser valves in shafts in city tunnel of Catskill aqueduct. Geo. Featherstone, Secy. Bd. of Water Supply.

Toronto, Ont., Can.—May 9, until noon, for two gasoline-driven diaphragm pumps. T. L. Church, Mayor, Chrmn. Bd. of Control.

Waterbury, Conn.—May 16, until 8 p. m., for driving tunnel and constructing appurtenant works in easterly part of town of Morris, Litchfield County. Probable cost $30,000. R. A. Cairns, City Engr.

CONTEMPLATED WORK.

Belleville, Ill.—Contract will be awarded about June 15 for straightening and deepening creek in Belleville, to cost about $79,600. W. C. Wolf, City Engr.

Buffalo, N. Y.—Construction of municipal paving plant is being urged by business men of city. Louis P. Fuhrman, Mayor.

Evansville, Ind.—Appropriation of $500 will be asked with which to have survey made of water front and tentative terminal plans prepared for first unit of city's proposed dock. Estimated cost of dock needed by city about $150,000. J. H. Rohsenberger, Chrmn. Chamber of Commerce Port Comm.

Vol. L. — No. 6.

Municipal Engineering

The World's Leading Municipal Publication

June, 1916.

ROADS FOR MOTOR TRUCKS

The expedition into Mexico has demonstrated the efficiency of the motor trucks where the roads are of a negligible quality, just as the European war has demonstrated that the motor truck is indispensable in moving and supplying the armies where the roads are good. The saving of Paris is credited to the automobile. While the commercial use of the motor trucks on poor roads or roads not heavy enough for their use will not develop rapidly, they will be used just as often as possible and they will just as inevitably cut the poor roads to pieces. They will be repaired only to be cut to pieces again immediately. The motor truck will, therefore, force the improvement of the roads by means of surfaces heavy enough to stand the strain. The states which have not yet begun the construction of such good roads in earnest will find their repair bills on the old roads mounting so fast that the new surfacing will be necessary as a matter of economy. Nothing short of this pressure will be able to start some communities.

Push the use of the motor truck; push the construction of permanent road surfaces; they will come together. The first will force the second. The second will make the first more rapid.

THE EDUCATION OF THE ENGINEER

What shall be the education to produce the engineer, the definition of whom was discussed last month, is the real question, and as then suggested, every school must train for the majority of the qualifications demanded by the definition. The product of the schools must have the ability to think accurately and consecutively. His natural powers of judgment, "horse sense," in the words of Prof. J. B. Davis, must be given the tools and the training with which to work. And experience indicates that the courses of study followed are not so important as the methods used in following them.

Elmer L. Corthell, the lamented president of the American Society of Civil Engineers, and his contemporary, George S. Morison, who died a few years since, are shining examples of the value of a purely classical education in developing ability to apply innate engineering trends. And while they may be considered engineering geniuses, in a sense, there are many examples among the older engineers of the same kind but less conspicuous, enough to demonstrate the thesis of the committee that a great majority of the engineer's education is not in the line of the acquirement of technical engineering information.

Whether these essential fundamentals of education can be obtained in a purely engineering school has not yet been demonstrated. While few would demand at this time that every engineer should have a fairly complete classical education as a basis for his technical training, the fact remains that the centuries of development of the classical system of education produced a marvelously efficient process of mental training. Unfortunately, modern tinkering with the system is reducing its efficiency. The so-called scientific education, now becoming more strictly technical, has not yet had time to develop equal efficiency in the fundamental training, tho it is making progress in that line. Such inquiries as that of this committee on engineering education show the dissatisfaction of the thinking public with the deficiencies in the education of the engineer and should do much toward finding out how to fill them. Meantime, as much of the old as can be taken as a basis for the new, should be the aim of every young man who has ability and aspirations for the higher walks of the engineering profession.

Two views of the present stage of advancement of technical education toward the ultimate goal of complete education of the all-round-man are given in the discussion of the product of the technical schools by Professors Swain and Mead in *Engineering Record*. The one sees the deficiencies of the present system and its failure to produce the results of the older system of education in inculcating the basic principles of all education, and the other sees the possibilities in the present system of development to include with the technical training the fundamentals of education not now sufficiently developed in that system.

Both the committee and the two professors are discussing the education of real engineers and not that of the men below the average in the schools, too many of whom are actually injured by the attempt made to develop something which is actually non-existent in them.

RESULTS OF FIRST CLEANING WITH SNOW PLOWS.

PROMPT SNOW REMOVAL

IN PHILADELPHIA, PA.

By William H. Connell, Chief of Bureau of Highways and Street Cleaning.

The author of this article is notable for his organizing ability and he gives here the results of his plans for being at all times during the winter in a state of preparedness for the severe contests with snow which, if successful, result in so much comfort to the citizens obliged to be on the streets. When it is possible to obtain such results on the large scale required in a city of the size of Philadelphia, it would seem to be easy to obtain the same results in the smaller cities. The problem is the same but is so much smaller in extent that an intelligent following of the plans here outlined ought to be possible with any competent superintendent of streets.

AN innovation introduced by the Philadelphia Bureau of Highways and Street Cleaning which has been operating successfully for the last three years, is the snow alarm or preparedness in the work of removal of snow. The conception and operation of the "snow alarm" in Philadelphia is one of the unique improvements in the Bureau of Highways which has resulted in greatly benefiting the community. Formerly it was the custom, not only in Philadelphia, but in other cities, to wait until the storm was over before beginning the work of removal. In other words, the city did not begin to dig itself out until after the storm had ceased. As a consequence, the traffic was often very seriously congested.

The main idea in a snow removal organization is "preparedness." At any hour of the night, as soon as the snow starts to fall, the electrical bureau notifies the chief of the bureau and the engineers in charge, by telephone, in their respective homes. One engineer living in the central part of the city is in constant communication with the weather bureau and the chief of the Bureau of Highways and as soon as the indications point to a continuance of the storm, the snow-fighting equipment is ordered out, upwards of one thousand telephone messages being sent to various parts of the city, calling out squad leaders, inspectors, snow plows, drivers, teams, laborers and officers in the various police districts, who aid in getting out the men.

In about one hour after the order is given, the horse-drawn plows and motor-driven plows attack the snow in the central business section of the city. These plows are supplemented by an army of laborers and teams who keep constantly at work day and night shovelling and dumping the snow into sewer manholes and the Delaware and Schuylkill rivers.

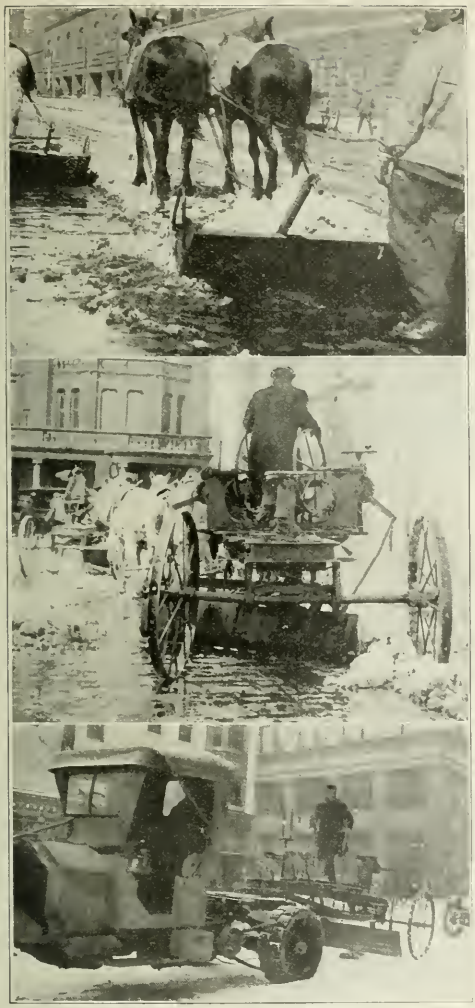
Every man in the snow removal organization has a particular function assigned to him. For instance, each dump inspector knows his post is at a certain dump, and he knows just what to do when he gets there; the driver of every snow plow and every team knows where he is to report, at what point he is to start to load, and at what sewer manhole or wharf he is to dump his loads, and there is no confusion.

Fighting the snow at night during some of the storms we have had in the past three years is no easy task for the Highway Bureau engineers assigned as squad leaders, the inspectors and the laborers, and it requires the constant presence of the chief of the bureau and his principal assistants to encourage the men and stir up the necessary enthusiasm to keep the work going.

In the central business section of the city snow is removed from all the thorofares. This work is performed under special contracts, supplemented by the regular street cleaning force, and is under the supervision of a special snow removal organization made up of men assigned to this work from the regular engineering staff.

Certain main thorofares and all the street crossings thruout the entire city are also cleaned by the regular street cleaning forces and a large municipal force assigned to the seven highway district engineers, who supervise this work. A large force is always employed opening up the country roads, where the drifts often completely block traffic. All told, the force employed on snow removal consists of an army of 4,000 men, 1,200 teams and the advance guard of 38 horse-drawn and 20 motor plows.

Of course, during the daytime the mobilization of the snow-fighting forces is comparatively an easy matter as compared with turning out this force at night, but as the main idea in the Philadelphia snow alarm is simply the practical application



EVOLUTION OF THE SNOW PLOW.

ABOVE: Snow scoops hauled by teams.

MIDDLE: Road graders hauled by teams and used as snow plows.

BELOW: Road grader hauled by motor.

of the principle of preparedness in the work of snow removal, the organization has been instructed in the methods that under the circumstances would seem to be best adapted to prevent interruption to traffic during and after a snowfall. It is a known fact that it is practically impossible to get a great number of laborers to work at night during a very severe storm, and to offset this, great stress has been laid on the use of the snow plows to keep the streets open to traffic. Of course, whenever the storm occurs in the day time or at night when the weather conditions are not too severe, considerable of the work is performed by flushing, sweeping and shovelling the snow into sewer manholes and inlets. This method, however, could not be depended upon in a storm such as the blizzard of February, 1913, as it would be practically impossible to get a sufficient labor force to work to keep the streets open to traffic under such severe conditions as existed the first night of the blizzard, and it is for this reason that we use every effort to keep the plows constantly at work plowing the snow to the side of the street during the progress of the storm. This has enabled us to keep the streets open to traffic when we have had difficulty with the labor situation. We have never had very great difficulty, however, in getting enough laborers and teams in the day time or at night to load the snow piled at the side of the street into the wagons and haul it to the dumps, but we do not depend entirely upon getting sufficient laborers to dispose of the snow by shovelling it into sewer manholes. This feature of the work is simply supplemental to the main feature, which is the use of the plows to keep the streets open to traffic, and after four years' experience with this method, we have concluded to increase the number of snow plows and place the main dependence upon them, as it takes very little time to get them on the work and it is possible to keep them at work at all times, even during the most trying conditions. Of course, when the snow is plowed to the side of the street, it simplifies loading it in wagons for disposal.

Early in the fall of each year, the several division engineers and district assistant engineers are required to prepare a complete assignment schedule for all of the forces under their supervision. This schedule constitutes a program of proposed operations and includes a definite assignment for each individual employe or gang, and indicates in detail the point to which each member of the force is to report and just what duties they are to perform. Prior to the advent of snow, the squad leaders are required to fully acquaint themselves with the traffic conditions existing in their respective snow removal

EVOLUTION OF THE SNOW PLOW.

ABOVE: Street railway snow plow with snow spreader attached.

BELOW: Snow plow mounted on heavy motor truck.

REMOVAL OF SNOW.

ABOVE: By horse-drawn wagons.

BELOW: By motor trucks. Note shovels of men not included by the camera.

districts and with the location and character of the assigned dumping places, the character of and the storage location of the contractors' equipment, and the names and call addresses of both the contractors and the inspectors assigned to their respective squads. They are also required to see that their inspectors and contractors are thoroly instructed in their respective duties, so that there will be no possibility of misunderstanding concerning any detail of the work.

All of the employes assigned to snow removal work understand that they are subject to call at any hour of the day or night, and in case of absence from their scheduled call address, are required to make suitable arrangements for immediately receiving any notice or order to report for duty that may be sent them. Each gang foreman is also made personally responsible for the notification and reporting on the work of a selected number of the regular municipal laborers living in his locality.

To insure the efficient operation of the snow removal work, the following instructions and forms have been provided:

(a) A set of detailed instructions which definitely indicate to the persons supervising the work the nature of the work to be done and the methods to be used in its performance.

DUMPING AND SHOVELING SNOW INTO SEWER MANHOLE.

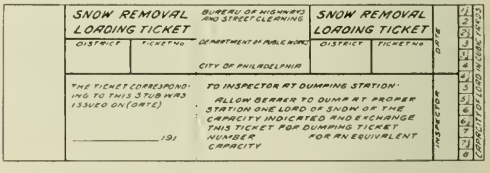
(b) A map indicating the highways included in each of the nineteen central snow removal districts and the nature and exact location of the snow dumps.

(c) An organization schedule indicating the name and call address and telephone number, and the assignment of each person detailed to snow removal supervision.

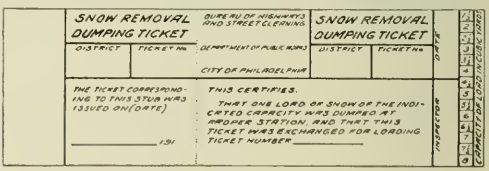
(d) Tickets of distinctive colors for loading and dumping respectively.

(e) Ticket issue records.

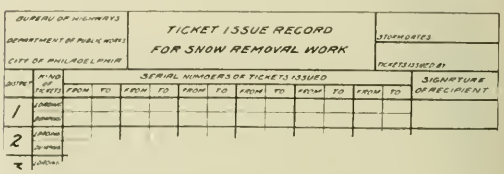
(f) Current status of work records.



SNOW REMOVAL LOADING TICKET
BUREAU OF HIGHWAYS AND STREET CLEANING
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA
DISTRICT
TICKET NO.
THIS TICKET CORRESPONDING TO THIS STUB WAS ISSUED ON (DATE) _____ 191
TO INSPECTOR AT DUMPING STATION:
ALLOW BEARER TO DUMP AT PROPER STATION ONE LOAD OF SNOW OF THE CAPACITY INDICATED AND EXCHANGE THIS TICKET FOR DUMPING TICKET NUMBER _____ FOR AN EQUIVALENT CAPACITY
INSPECTOR
CAPACITY OF LOAD IN CUBIC YARDS



SNOW REMOVAL DUMPING TICKET
BUREAU OF HIGHWAYS AND STREET CLEANING
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA
DISTRICT
TICKET NO.
THE TICKET CORRESPONDING TO THIS STUB WAS ISSUED ON (DATE) _____ 191
THIS CERTIFIES
THAT ONE LOAD OF SNOW OF THE INDICATED CAPACITY WAS DUMPED AT PROPER STATION, AND THAT THIS TICKET WAS EXCHANGED FOR LOADING TICKET NUMBER _____
INSPECTOR
CAPACITY OF LOAD IN CUBIC YARDS



BUREAU OF HIGHWAYS
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA
TICKET ISSUE RECORD FOR SNOW REMOVAL WORK
STORM DATES
TICKETS ISSUED BY:
DATE
KIND OF TICKETS
SERIAL NUMBERS OF TICKETS ISSUED
FROM TO FROM TO FROM TO FROM TO FROM TO FROM TO
SIGNATURE OF RECIPIENT
1 LOADING DUMPING
2 LOADING DUMPING

TOP: Ticket given driver when he leaves the street with a load.

MIDDLE: Ticket exchanged for the above when load is dumped.

BOTTOM: Heading of record sheet keeping account of all tickets issued, both for loading and for dumping.

BUREAU OF HIGHWAYS AND STREET CLEANING
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA

SQUAD LEADER'S DAILY REPORT ON SNOW REMOVAL WORK

DISTRICT No.
DIVISION No.

PLOWING FORCES / REMOVAL FORCES	ORDERED TO REPORT FOR DUTY	AM PM	REPORTED ON THE WORK	AM PM	NUMBER OF TICKETS ISSUED	AM PM	LOADING	DUMPING
		AM PM						

WORK PERFORMED ON THIS DATE

CHARACTER	ON	FROM	TO	QUANTITY LOADS	QUANTITY CUBIC YARDS

FORCE EMPLOYED ON THIS DATE — INSPECTORS

LABOR AND EQUIPMENT	NUMBER	HOURS WORKED	HOURS IDLE	NAME	ASSIGNMENT	STARTED	STOPPED	HOURS
FOREMEN								
LABORERS								
HORSE PLOW OUTFITS								
HORSE-SHOVEL OUTFITS								
MOTOR PLOW OUTFITS								
DOUBLE TEAMS								
MOTOR TRUCKS								

CONTRACTOR NAME

WEATHER CONDITIONS — TEMPERATURE MINIMUM — MAXIMUM

DELAYS REASON AND DURATION

INSTRUCTIONS RECEIVED FROM ASSISTANT ENGINEER

TIMES OF YOUR REPORTING ON THIS WORK — COMMENCEMENT — COMPLETION

REMARKS

DATE OF THIS REPORT ..... 191 — SUBMITTED BY ..... SQUAD LEADER — APPROVED BY ..... DIVISION ENGINEER

(g) Squad leaders' daily reports.

(h) Squad leaders' daily report summary.

The central business section is divided into nineteen districts, each district being under the supervision of a squad leader, to whom is assigned a number of inspectors, some of whom supervise the removal of the snow, while others see that it is properly disposed of at the dumping places. The inspectors supervising the snow removal see that the snow is properly plowed into windrows adjacent to the curb, and then piled out and hauled to the dump. They are also required to measure and calculate the cubical capacity of all hauling vehicles and see that these vehicles are properly loaded, after which they give the drivers loading tickets, which are exchanged at the dump for another ticket which is retained by the driver, and upon which payment is made.

The inspectors at the dumping places are required to see that the snow is properly dumped and that no improper material likely to obstruct the sewer is mixed with the snow. In the sewers where there is not a sufficient flow of water, a water jet has been provided, which serves to increase the flow in the sewer and this is regulated by the inspector.

All inspectors on both the loading and dumping work are required to see that the work is performed in such manner as to entail the least possible interruption to traffic.

After the beginning of operations, each squad leader makes hourly reports to the main office of the force of labor and equipment on the work, and also of the general conditions existing in his respective district. These reports are entered on the current status of work record, which greatly assists in the administration of the work.

Each squad leader is also required to make a daily report which indicates in detail the character and quantity of the work performed, the force employed and other appurtenant details.

The highly satisfactory results produced thru the operation of the snow-fighting forces under this system in the past several years has proven conclusively that the efficient administration of snow removal work is fundamentally a matter of preparedness based upon an exhaustive study of the requirements of the work and the establishment of a proper organization; the provision of a definite and adequate procedure, and the thoro instruction and drilling of the snow-fighting forces in the requirements of their respective duties.

BUREAU OF HIGHWAYS AND STREET CLEANING
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA

CURRENT STATUS RECORD OF SNOW REMOVAL OPERATIONS

DISTRICT No.
DIVISION No.

REPORTED AT: ..... FORCE AT WORK

DATE	TIME	LABOR: NUMBER	EQUIPMENT: HORSE PLOWS	HORSE SHOVEL PLOWS	MOTOR PLOWS	MOTOR TRUCKS	PROGRESS AND CONDITIONS	REPORTED BY

BUREAU OF HIGHWAYS
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA

SUMMARY OF SQUAD LEADERS' DAILY REPORTS ON SNOW REMOVAL WORK

DISTRICT No. — DIVISION No. — STORM DEGREES — REMOVAL DATES

DATES OF WORK IN PROGRESS	FORCE EMPLOYED: FOREMEN	LABORERS	EQUIPMENT EMPLOYED: HORSE PLOW OUTFITS	HORSE SHOVEL PLOW OUTFITS	MOTOR PLOW OUTFITS	DOUBLE TEAMS	MOTOR TRUCKS	SNOW REMOVED: LOADS	CUBIC YARDS

TOTALS																				
UNIT																				
TOTAL																				
UNIT																				
TOTAL																				

TOTAL QUANTITY IN CUBIC YARDS OF SNOW REMOVED

TOTAL COST — CONTRACT — ESTIMATED

UNIT COST — CONTRACT — ESTIMATED

PLANNING BOARD
OFFICE OF ASSISTANT ENGINEER IN CHARGE OF SNOW REMOVAL WORK

GRAPHIC PROGRESS RECORD USED IN CONNECTION WITH SNOW REMOVAL MAP

BUREAU OF HIGHWAYS AND STREET CLEANING
DEPARTMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA

CHARACTER OF EQUIPMENT AND LABOR	CURRENT CONDITIONS	SNOW REMOVAL DISTRICTS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
MOTOR PLOWS	NUMERICAL STRENGTH	
	INSPECTED AT PLANT	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
HORSE-DRAWN PLOWS	NUMERICAL STRENGTH	
	INSPECTED AT PLANT	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
MOTOR TRUCKS	NUMERICAL STRENGTH	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
TEAMS	NUMERICAL STRENGTH	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
EMERGENCY SNOW REMOVAL FORCES	NUMERICAL STRENGTH	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
REGULAR STREET CLEANING FORCES	NUMERICAL STRENGTH	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
MUNICIPAL MAINTENANCE FORCES	NUMERICAL STRENGTH	
	READY FOR WORK	
	ORDERED TO WORK	
	BEGAN WORK	
	ORDERED TO SUSPEND WORK	
INSPECTORS	NUMERICAL STRENGTH	

THREE RECORDS OF SNOW REMOVAL.

ABOVE: The continuous record of conditions on the street, kept up to the minute while snow removal work is going on.

MIDDLE: Summary of squad leaders' daily reports.

BELOW: The Planning Board in the office of the assistant engineer in charge of snow removal work, used in connection with a city map with the districts defined on it and tacks of different colors and designs to designate the classes of apparatus and men engaged and places where they are at work.

BUILDING CONCRETE ROADS

IN LAKE COUNTY, OHIO

By Homer P. Cumings, County Engineer, Painesville, Ohio.

A practical article, unusual because it gives an account of some failures to obtain the best results, explains the reasons for them, and shows how the mistakes were corrected in later designs and construction. The article is therefore of much value to contractors and to engineers and will well repay careful study. It is by the engineer in charge of the work and responsible for all the designs except those for the pavements under construction when he took the office of County Engineer. The paper was read before the Ohio Engineering Society.

THE first concrete road in Lake county, Ohio, was built in the summer of 1912 under state specifications and state supervision, leading south from the village of Madison 1.41 miles long, width 12 feet, thickness of concrete 6 inches, cross-slope 2 inches. The pavement was laid to one side of the center of the road with an earth road alongside. Width of berm on outer side of pavement, 4 feet. Drainage was provided for by open ditches on either side, 2 feet in depth. The road has a sufficient longitudinal grade at all points to insure a ready flow of water in the ditches. The soil is a heavy clay. It was reported to be the worst soil in Lake county to heave. I was placed in charge of this work when the construction was more than half completed. Well do I remember the first day that I went onto the job. The contractor was present in person and I believe he was trying to build a good road. The concrete was being mixed by hand on a wood platform or by a mixer that was not intended for road work, according to whether the hands or the mixer seemed to be in the best working condition that day. A good quality hard blue limestone running up to about 2 inches in size was used as the coarse aggregate. The fine aggregate was lake sand hauled by teams from the lake, 6 miles away. It was a one-course job and the mix specified was 1:1½:3½. The surface was finished with a wood float and after the entire 1.41 miles were completed it was cleaned as thoroly as possible and given a surface treatment of tar. The cleaning process was no joke, as the pavement had been covered with clay to aid in curing, and a considerable portion of it had been traveled over for several weeks. Steel brooms, reed brooms and barn brooms were used, and we hoped that what clay didn't come off would be absorbed. Perhaps this was the case for over the greater part of this pavement the tar stuck well. Over a stretch of several hundred feet in one location it peeled off badly the first winter, without any reason that I was able to discover. This was repaired the following spring and has since stood as well as the other portions. This pavement was laid in blocks 30 feet in length. When I looked at it on the occasion of my first visit to the job and thought of what that clay did when the frost went out in the spring, I asked the contractor if he didn't expect the pavement would break all up in the spring. His reply was, "Oh, I guess not." And it has not. A considerable portion of the tar surface (less than half) has disappeared, going off in small patches and leaving the pavement with a mottled appearance. The surface of the concrete where the tar has disappeared is showing no marked amount of wear. A few cracks have appeared, perhaps half a dozen would come close to covering the number. The pavement is in good condition, and is the pavement that convinced me that concrete can be laid on a clay soil and not break up from the effects of freezing and thawing. The contract price of this pavement was $11,970. The contractor assures me, however, that those figures do not indicate what the pavement actually cost.

The second concrete pavement was laid in the summer of 1913, on the Weeds Corner Extension Road. This pavement is 2.21 miles in length, 12 feet in width and 6 inches thick. It was built under state specifications and is a two-course job. The cost was about $25,000. The soil is clay. Drainage is provided for by open ditches. The specifications read "foundation course shall consist of 1:2½:5 concrete 4 inches in depth; top course shall consist of a 1:1½:3 concrete 2 inches in depth." The coarse aggregate for the base was to be graded in size from ¼ inch to 1½ inch, and for the top from ¼ to 1 inch. This pavement was in fact built with a local creek gravel as the coarse aggregate for the base. This gravel was of a very fair quality and conformed quite well with the requirements of the specifications. The fine aggregate was a creek sand from the same location as the gravel, and showed up exceptionally well in the tests to which it was subjected. The coarse aggregate for the top was obtained by crushing boulders collected from the nearby fields. A large per cent. of these boulders were granite and supplied a crushed rock of very good quality. There were, however, among them some of a soft or dead quality, the nature of which often could not be detected until they were crushed and then it was too late to keep them out of the mass of stone used. This, we believe, to account for the fact that numerous holes have formed in the surface of certain parts of this pavement, pockets of this soft rock having given way under traffic. The surface of this pavement was finished with a wood float and with a light cross stroke with a coarse brush. Before the concrete was opened to traffic, the surface was thoroly broomed with steel brushes and a coating of tar and granite screenings, applied. When the supply of screenings from the crusher plant was exhausted, the remainder of the surface was covered with fine silica gravel. The screenings seemed to give the more satisfactory surface. This tar coating, however, has not proven satisfactory. It began peeling off badly the first season after being completed and today about one-half of the surface is bare. This pavement has had a considerable amount of heavy traffic. Three blocks have broken badly, due to settlement of a fill. Considerable cracking has occurred, about 100 blocks being broken out of a total of 390. Some displacement has taken place at joints, due, I think, chiefly to settlement of blocks. All of the material used in a 1.34 mile extension of this pavement was hauled over it in automobile trucks in the summer of 1914. Quite extensive repairs to the surface of this pavement are scheduled for the coming summer.

In the summer of 1914 an extension of this pavement was built. This extension was 1.34 miles in length and was similar in every way to the one just described, except that the top course was a 1:1:2 concrete; slag was used for the coarse aggregate in the base and silica gravel in the top for about one-half of the job and hard limestone in the top for the remainder. No tar was used on the surface of this pavement. The surface is today in almost perfect condition, but a considerable amount of cracking has taken place, about 100 blocks being broken. A very close examination is required to detect the difference in

the surface where the silica gravel was used and where the limestone was used. Both are in equally good condition and hardly a flaw can be detected except the cracks. The contract price of this work was $17,115. In both of the last two described pavements the cracks are about equally divided between longitudinal cracks and transverse cracks, but in either case, nearly all occur in the middle one-third of the block.

Also, in the summer of 1914, 9.8 miles of county road were built in the township of Madison, under two contracts, one for 5.43 miles on the Madison South Ridge Road and one for 4.37 miles on the Lake-River Road. The South Ridge Road, as its name indicates, is laid on the southerly one of three natural sandy ridges running in an easterly and westerly direction thru this part of the county and very nearly paralleling the south shore of Lake Erie. While this ridge is for the most part of a sandy and gravelly nature, yet numerous springy and treacherous spots occur in it, so that while it was a deep sand bed for traffic in the summer, it offered many mire holes in the wet season. The longitudinal grades on the greater portion of this road are light. Drainage was provided for by open ditches, 1½ feet deep, by storm water sewers with numerous inlets and by tile drains discharging into the inlet basins. A street car track lies along one side of this road for about one-half its length. A 4-inch tile drain was laid the entire length of this track in the center of the strip between the track and pavement and 30 inches below the surface of the pavement.

This pavement is 16 feet wide, 6 inches thick at the edges and 7 inches thick in the center, the surface having a crown of 1½ inches. This is a one-course pavement, the proportions of cement, fine aggregate and coarse aggregate being 1:2:3½.

The fine aggregate was a dredged lake sand. Our only difficulty in keeping this sand up to requirements was to get sand that was sufficiently coarse and it was necessary to reject a number of carloads on this score. The coarse aggregate was the very hard, round, smooth pebble which we know as silica gravel. The condition of this pavement at the present time would indicate that a concrete built with this pebble offers a wearing surface almost indestructible under the abrasive wear of ordinary traffic, but also gives a body lacking in tensile strength. The surface of this pavement is as handsome a specimen of road surface as one could wish to see, with hardly a defect in it, except for the cracks. It doesn't seem to know where to stop cracking, except when it comes to a block that was reinforced. Then it usually stops. Some ninety blocks were reinforced with American Steel and Wire Co.'s triangle mesh No. 28. These blocks were in wet or springy places or on fills or where sewer trenches had been excavated. Out of these ninety blocks about a half dozen have fine cracks. These have not opened up so as to cause any damage whatever. You can follow a longitudinal crack down the center of this pavement block after block till it comes to a block that was reinforced because of a sewer trench. This block will be perfectly sound and the crack will begin again on the other side. In one section seventeen blocks were reinforced because of a fill of from 1 foot to 4 feet in depth. Not a crack has appeared in any of these blocks. In passing thru the business section of Madison village this road was paved from 40 to 45 feet in width. These blocks are all reinforced. Only a few cracks have appeared and none of these have opened up. One has to look closely to discover them. The blocks in this pavement are 33 1/3 feet in length. A few transverse cracks have appeared, but the most of the cracks are longitudinal. These cracks nearly all appear in the middle one-third of the block. Tho the number of cracks in this pavement is very great, but very few of them have as yet opened up so as to do any damage whatever to the pavement. The great majority of them are mere hair lines.

The first half mile of this pavement was laid with ⅜-inch expansion strips at the joints, with no armor plates. The edges of the blocks at these joints have rounded off, but the ravelling has increased but very little since the first few months of traffic. After the first half mile was laid all joints were armored with Kahn plates. These joints are in practically perfect condition except where the concrete was left too high and floated over the plates, in which cases the edges of the blocks have rounded down to the plates. Very little, if any, chipping back of the plates has occurred.

The cost of this road was $97,909.37, which I have divided into four general groups as follows: Grading, $11,465.50; drainage, $13,082.17; pavement, $71.738.26; masonry and culvert repairs, $1,623.44. Notwithstanding the one defect of numerous cracks in this pavement, I believe it will give long and satisfactory service with a very small cost for maintenance.

The Lake-River Road runs in a north and south direction and extends from Lake Erie on the north to Grand River on the south. The part of this road that was paved is a section 1 mile in length, running south from the South Ridge Road at Madison village and a section 3½ miles in length running north from said village. The greater part of the south mile is on clay soil. The north 3½ miles are on a lighter and more sandy soil with numerous wet and quick-sandy places. The first mile north from the village has always been an exceptionally difficult piece of road to keep in a passable condition. A longitudinal grade sufficient for good drainage exists on nearly the entire length of this 4½ miles. This pavement was built under the same specifications as the South Ridge pavement. The width and depth of concrete were the same, and about a proportionate amount of tile drainage and sewer work were done. A good quality of well-graded washed gravel was used for the coarse aggregate. This gravel ran somewhat coarser in size than the silica gravel used on the South Ridge and the pebbles were not so smooth and glassy in surface. The sand used in the first mile either way from the village was from the same source as the sand used on the South Ridge, while the sand used in the north 2½ miles was from a local pit. This pit sand was of excellent quality, but was too fine to be entirely satisfactory. The same difficulties in securing a sufficiently coarse sand were experienced in the early shipments for this road as noted on the South Ridge Road. Some of this defective sand got into the first mile of pavement north of the railroad at Madison and we believe is partially responsible for certain defects that have appeared in this mile of work. This was the first section built on this road. As soon as the last block laid was three weeks old, hauling over it of material for the 2½ miles north of it was begun. At numerous places in this mile of pavement, the surface has worn down under traffic, showing depressions at these spots of usually from ½ to 1 inch. The most of this wear seems to have occurred during the first few months after the pavement was opened to traffic, very little additional wear having occurred at these places during the past summer. We believe some of these defects to be due to poor sand, but a greater cause to be the breaking of the bond in the surface of the concrete by too heavy traffic before the concrete was old enough to withstand this traffic. I have observed that a traction engine with lugs on the wheels which would chip the pavement in passing over it the first season after it was opened to traffic, will now pass over it without leaving a mark, showing conclusively that the pavement is not at its best for a long time after it is laid and that traffic should be kept off from it as long as a long-suffering public can be made to suffer. Except for this 1 mile, the surface of the pavement on the Lake-River Road is practically as perfect so far as abrasive wear is concerned as the day it was opened to traffic. The pavement has cracked to a considerable extent, tho not nearly as much as the silica gravel concrete on the South Ridge Road. Yet where cracks have occurred they have opened up and damaged the

pavement to a far greater extent than is the case on the South Ridge.

The cost of this road was $72,841.07, divided into the four groups, as follows: Grading, $5,992.04; drainage, $10,354.45; pavement, $56,430.58; masonry, $64.00.

As on the other road, the length of the blocks was 33 1/3 feet. Except for the first half mile laid, all joints were protected with Kahn plates, a ¾-inch expansion strip being placed between the plates. These joints are in practically perfect condition today. At some of the wet and treacherous places, blocks were reinforced with rib metal reinforcement size No. 6 as manufactured by The Trussed Concrete Steel Company. In all, nineteen blocks were so reinforced. Not one of these blocks shows any crack or defect of any kind.

Our experience with the Madison pavements, not only in the matter of the cracking of the concrete, but also because of difficulties we experienced in securing a uniform grade of gravel for a coarse aggregate, determined us to use only a crushed rock for the coarse aggregate in the next concrete pavement to be built in Lake county, and also determine us to reinforce all concrete pavements hereafter built. Following out this decision, contracts were let in the spring of 1915 for paving with concrete three roads in the township of Perry, aggregating 9.73 miles as follows: The Perry South Ridge Road, 5.12 miles, which is an extension westerly of the Madison South Ridge Road; The Narrows-Center Road, 2.38 miles, a road running northwesterly from the South Ridge Road and passing thru the village of Perry, and the Call Road, 2.23 miles, running northeasterly from The Narrows Road.

The first two of the above named roads were completed during the past season. The concrete pavement is 16 feet wide, 6 inches thick at the edges and 7½ inches thick in the center, the surface having a crown of 1½ inches. Soil conditions were similar to those in the Madison work and the same attention was given to drainage as on that work. The concrete was laid in two courses, the base being 4 inches thick at the edges and 5 inches thick at the center. The top course is 2 inches thick at the edges and 2½ inches thick at the center. A 1:2½:4 concrete was used in the base, the coarse aggregate being a hard limestone; the top is a 1:1½:2½ concrete, the coarse aggregate being trap rock, graded in size from ¼ inch to 1¼ inches. The blocks are 33 1/3 feet in length. Joints are armored with Kahn plates separated with ¾-inch expansion strips. Every block is reinforced with Kahn road mesh No. 25, placed in the upper part of the base course. The sand used in the greater part of this work was from a local pit and tests made upon it from time to time showed it to be of excellent quality and well graded.

One of the novel features in the construction of the work was in the use of bulk cement. With the exception of the first mile or so of the work on the South Ridge, all cement for this work was shipped in bulk. This was handled in the following manner: Cement-tight wagon boxes were used. These were placed so that top of box would be level with car floor. An 8-foot coal chute was then hooked onto the planking across the car door opening, with the end resting in the wagon box. The cement is then shoveled into the chute until the car is cleared from door to door over a space about the width of the door opening. After this opening is made in the car, a low-hung, open-end cart is used, the body of which holds five sacks of cement. One man handles the cart, loading it by driving the open end into the cement and completing the filling with about three strokes of a winged hoe. He then wheels it to the wagon over a platform spanning the opening between car and wagon, and dumps it. On the line of the work, six boxes are used for receiving the cement. These boxes are fitted with a movable ridge pole to support a canvas cover which thoroly protects the cement from storm. The cement is shoveled from the wagon into coal chutes hooked over the wagon box with the end resting in the receiving box. Each box is filled to a fixed point which furnishes just enough cement for a given length of pavement. The cement is shoveled upon the receiving boxes into measured wheel barrows and wheeled to the mixer.

The handling of cement in bulk proved very satisfactory. There was less waste than with sacks. Absolutely no cement was damaged by storms. The inspector could check the amount of cement used more easily than with sacks. And the contractor had no sacks to bother with and no money tied up in sacks.

Another matter that interested us considerably was an experience early in the season when bulk cement was being used at the east end of the road and sacked cement at the west end of the road. The stone and sand were the same on both jobs. The bulk cement and the sacked cement had shown about the same results in the tests that had been made. Both cements had developed some heat in the car but had tested out all right. Both were from the same company and shipped at the same time. Yet with several days in succession of very drying weather, considerable difficulty was experienced in preventing checking of the surface, as the concrete began setting up on the job where the sacked cement was being used, while very little difficulty of this kind occurred on the job where the bulk cement was being used. Did the three times that the bulk cement had been shoveled over have anything to do with it?

The cost of these pavements was as follows: The South Ridge Road, $80,226.20, with the following division among the four groups: Grading, $6,275.10; drainage, $6,529.06; pavement, $67,077.34; masonry, $344.70. The Narrows-Center Road cost $42,718.94, divided as follows: Grading, $4,053.27; drainage, $5,925.67; pavement, $32,590.00; masonry, $150.00.

These pavements are now going thru their first winter. It is, of course, too early to be able to say what they will eventually show. Yet they have already passed thru four periods of moderate freezing, one period reaching to about the zero point, followed each time by a sudden thaw and complete break up. Up to the present time, I have not been able to discover one crack or defect of any kind in the entire 7.5 miles, tho I have made several careful inspection trips over them. Neither has anyone reported any crack or defect to me.

Out of six roads herein described, each somewhat different in its construction from the other, we have pinned our faith to the Perry construction.

A concrete pavement, to be worth while, must be constructed with first-class workmanship and first-class material. Nothing less will do. But past experience and experiments indicate that, with these two ingredients, the concrete pavement will make for itself in the coming years, a worthy record.

About 20 miles of pavement were under contract in 1915. In 1916 about 14 miles of road will be paved with brick and concrete, mostly the latter. Very careful supervision is given to all our work, both by the engineers and by regular inspectors, who are continuously on the job, yet our engineering and inspection usually amount to about 3 per cent., never over 4 per cent.

Full Meterage of Water Supply

AT MILES CITY, MONTANA.

By G. C. Pruett, City Engineer.

DOES it pay to install water meters, is a question which is receiving at the present time more attention, perhaps, than any other in the water works field; and justly so, because of its importance.

First, by installing meters it is possible to forestall extensive improvements and extensions to the plant by reason of the reduced consumption following a general meter installation.

Second, it places all consumers on an equitable and comparable basis.

No other business would consider for a moment the sale of its product except on a measured or unit basis, and the reason for not doing so in the case of water, where it is possible to meter, is certainly not explainable.

Where water is pumped, as it is in most instances, or where it is piped thru expensive conduits from costly supplies at some distant source, the cost of installing meters can generally be saved many times over on the cost of the original installation. Not only this, but the cost of maintenance will in most, and I believe in all cases, be less than the extra cost of maintenance and operation of the plant installed without considering the use of meters, not even taking into consideration the extra interest, depreciation and reserve necessary for the larger and more expensive plant.

I have found in my experience at Niles City, Montana, first with a flat rate plant and later with one 100 percent metered, that, after getting the meters installed, the general satisfaction from the customers is greater than it was on the flat rate basis.

First of all, ours is a municipally-owned plant, and by constantly keeping this matter before the community, the citizens have come to regard the plant as belonging to them, and realize that all additional expense caused in operating the plant must necessarily be borne by them. They have, therefore, welcomed the introduction of meters, for by doing so they know that every person using water is placed on the same equitable basis, and that the water hog will pay his proportionate share of the expense.

The matter of installing meters first came up in Miles City in 1911, but not having been sufficiently explained, it met with some objection, and the ordinance authorizing the installation of meters was served with a referendum notice which required that it be submitted to a vote. The election was held in the early part of 1912, and, needless to say, carried by a good majority; in fact, by a vote of 3 to 1.

The original intention under the ordinance was to begin metering gradually, getting first those using the greatest amount of water without a proportionately higher rate, and those who intentionally or carelessly wasted it, with a further provision that anyone else desiring it could have a meter installed by making application to the superintendent. After a number of installations on consumers known to be using a greater amount of water than they were paying for, and who naturally objected, and a few on application, I found that applications came in so fast that I could not take care of them. At the end of two months not less than 75 percent of our consumers had made application for meter service.

The meters were furnished and installed by the city without cost to the consumer except in cases requiring the rearranging of pipes, the cost of which was charged to the consumer at cost. I have found, here and elsewhere that the only practical way is for the utility to furnish, instal and maintain the meters, with proper regulations as to damage caused to the meter by neglect or carelessness on the part of the consumer. By this method the utility has proper control over the meters at all times, without going thru a lot of preliminaries, as would be the case with privately owned meters. The utility's forces under proper organization instal meters a great deal cheaper than the plumbers, and the installations are more uniform and systematic.

Meters, admittedly, will reduce the amount of water necessary to be furnished, and inasmuch as each gallon has a certain monetary value, a reduction in the number of these gallons will cause a reduction in the total cost of production.

With a meter schedule established so that the gross revenue will about equal the gross revenue from the flat rates, a few will have to pay a great deal more than they would under the flat rate, but the majority will not. In Miles City over 75 percent of the consumers are getting off cheaper under the meters than they were formerly under the flat schedule, altho the total gross revenue from the plant is substantially the same. The difference is paid by the 25 percent who were formerly getting more than they were paying for.

The saving to the utility is caused by the reduced cost for power, piping systems, conduits, filtering equipment, pumping units and general operating expense. I do not mean by this merely the reduced cost incident to the operation of the plant, but the cost of interest, depreciation and reserve, which would be required by the larger installation.

The question might then be asked, would it pay to instal meters in a plant already in operation and of ample capacity to supply present needs? I would again say, yes, i. e., provided the supply was pumped or treated, and generally speaking, in other cases also. It will be found with a pumped or treated supply that the reduced cost for power and chemicals will offset the extra cost for operating and maintaining the meters, and will also provide a reserve which will pay for the cost of the meters in from two to five years, provided the rates are such as to produce substantially the same gross revenue. If the supply is by gravity and ample, the meter system is still the only equitable and reasonable basis on which to render bills. Each consumer is then paying for his own supply in proportion to the amount used, while his neighbor is doing the same. Furthermore, where meters are installed, one does not find the lack of a satisfactory pressure, as is so often the case during the sprinkling hours with an unmetered system. This in itself should have some consideration, especially from the standpoint of fire protection.

Where the plant has reached or nearly reached its capacity, and enlargements are being considered, the most economical, and generally the most satisfactory solution of the problem will be found in the introduction of meters. Referring again to the plant at Miles City, at the time of installing meters we had about reached the capacity of our plant. To have provided a plant of ample capacity, with our prospective increase in population, and the rate of consumption at that time, would have required the expenditure of approximately $75,000. The cost for power (electricity) and chemicals at that time was approximately $7,000 per year. At the present time, on the same basis of consumption, the cost would be approximately $12,000 per year, but as a matter of fact is, with meters, only $6,000 per year. This is a saving of $6,000 per year, which, added to the $6,000 per year interest and depreciation on the $75,000 extension, shows an apparent saving of $12,000 per year. I say apparent for the reason that the meters installed cost $12,500, interest and depreciation on which amounts to $1,937.50 per year. Add to this the extra cost for maintenance and operation, $1,100 per year, gives a total of $3,037.50 to be deducted from the apparent saving, leaving a balance of $8,962.50 on the credit side of the ledger, a very good showing on an investment of $12,500.

Wood Stave Pipe Construction

Wound with Electrically Welded Continuous Wire

THE accompanying illustrations show the wood stave pipe wound with continuous electrically welded wire, under construction for the California Pine Box and Lumber Company, at Delleker, Cal. The compressed air was furnished by a portable gasoline engine and air compressor, and the electric current for welding was supplied by a small generator driven by the same gasoline engine.

Some most interesting problems were encountered in connection with this pipe laid on a compound curve thru a concrete wall. If sectional machine-banded pipe with collars and joints had been used on this particular part of the pipe line, no lengths longer than 4 inches could have been used on account of the curvature.

The photographs show the operation of the winding machine and the finished pipe ready for lowering into the trench. In addition to making the pipe continuous, this method does away entirely with the necessity of collars and joints, which must be used in sectional machine banded pipe.

Experience has very conclusively shown that the use of collars and joints is largely responsible for unfavorable leaks and for deterioration of the pipe at the joints. This new type of wood stave pipe has recently been developed in California and has been used in building two conduits of considerable length. Engineers are familiar with the continuous wood stave pipe in which the staves are secured by steel hoops secured by nuts and with the smaller sizes of wood pipe with the exterior of the pipe wrapped with a spiral wire winding, the pipe being made up in convenient lengths with the wire winding secured at the end. In laying pipe of this latter class, joints are required between the successive lengths of pipe.

ELECTRICALLY WELDED WIRE-WOUND WOOD-STAVE PIPE.

ABOVE: The machine for winding the wire about the pipe and the welding apparatus in operation.

BELOW: The completed pipe ready to lower into the trench.

The new type of pipe is a continuous stave pipe wrapped with a continuous helical winding of wire. The wire is wound on the pipe, as it is built over the trench, by a machine which winds the wire with a uniform tension and uniform pitch, both the tension and the pitch being adjustable according to the size of the pipe and the water pressure which it is to sustain. The machine is a simple and rugged affair, and has a gear wheel which encircles the pipe and is driven thru speed-reduction gearing by a small compressed-air motor. As this gear wheel is rotated around the pipe it is at the same time given a longitudinal motion along it. This rotating gear wheel carries rollers between which passes the wire to be wound on the pipe, and these rollers are adjustable to give the wire the desired tension. The wire is unwound from a reel that encircles the pipe head of the machine. When a new reel of wire has to be put on, the ends of the wires are welded together by a miniature electric welder furnished with the apparatus. After the electric welding, the joint is regalvanized. The necessity for the electric-welded joint arises from the fact that in order to pass thru the machine with even tension the wire must be of uniform diameter and flexibility, a result which could not be obtained with the telegraph lineman's splice.

As soon as the wire is wound on the pipe and before it is lowered into the trench, the entire pipe with the wire winding is given a heavy coating of asphalt. A sleeve slightly larger than the pipe has elastic and flexible ends made of fabric which fits snugly over the pipe. By means of a funnel on top, this sleeve may be filled with hot asphalt and it is then driven slowly along the pipe. By using galvanized wire and heavily coating the pipe with asphalt a long life for the pipe is assured.

The first pipe of this type was laid by the Standard Oil Co., of California, near Bakersfield, to furnish a water supply to a refinery. The pipe is 18 inches in diameter, about 2,400 feet in length and carries a maximum head of 60 feet. The California Pine Box and Lumber Company's line is 6,500 feet long and 10 inches in diameter and is under a maximum head of 200 feet. About 180,000 feet of No. 4 galvanized wire was used on this line, and 120 welds were made. The spacing of the wire was from 1 1/16 to 2 7/16 inches, according to the head of the pipe.

The line was laid thru very rough country and some curves as sharp as 30 degrees were made. The pipe was laid at the rate of about 450 feet per day. This pipe is low in cost, especially for pipe lines of small diameter.

The staves for the pipe can be shipped at much less cost than the made-up lengths of pipe. The pipe can be bent to sharp curves as it is built up, and a great deal of expense in carrying a pipe line thru rough country is saved by adapting the pipe line to the contour of the ground. The wire used is of 60,000-pound tensile strength and wire of various diameters is used, according to the size of the pipe and the pressure to be used in the pipe line.

THE QUINCY SHORE BOULEVARD

OF THE BOSTON METROPOLITAN PARK COMMISSION

The details of construction of this boulevard are told by the contractor in a brief recital of some of the difficulties met in what seemed to be a comparatively simple problem. The article will therefore be of interest particularly to contractors and to their engineers.

THE Quincy shore boulevard of the Boston Metropolitan Park Commission was built during 1915, actual work beginning about May 1.

The parkway constructed is 1.75 miles in length and the specifications up to the sub-grade called for the following quantities which were paid for at the prices given:

40,000 cubic yards earth grading, at 23 cents.
100,000 cubic yards filling, at 43 cents.
15,000 feet b. m. 2-inch spruce, at $50.
5,000 square yards rip-rap, at $2.15.

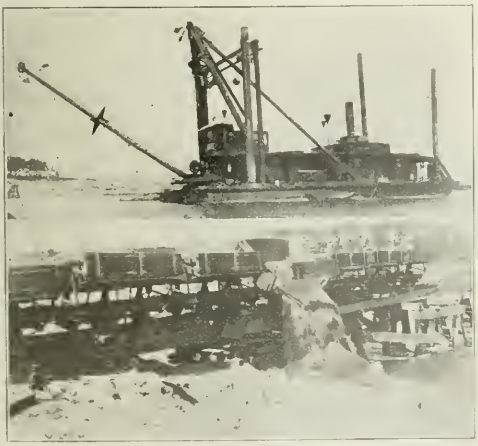
Most of the fill was in the two approaches to a proposed bridge and the amount of the filling was materially larger than that called for by the specifications, due to the fact that there was about 30 feet depth of mud on the bottom of the river into which the gravel used for filling must settle to reach a solid base.

The contractors first planned to bring up dredged material in scows and deposit it in place with a rehandler, but not having any contract providing suitable material for the purpose, a pile bridge was built, as shown in the lower of the first group of photographs, and cars were run out on either end and dumped over the side, as shown, until the grade was brought up level with the rails. The track was then thrown and dumping continued until the required width, about 60 feet, was obtained.

It was thought that material deposited in this way would work its way to hard bottom, so that pile foundations could be driven for the bridge abutments. The fills settled continually, going down 5 or 6 feet over night. The continued pushing of mud away from the approach fills forced the pile bridge up stream, so that it was necessary to rebuild the bridge. To save the cost of leaving material not paid for in the pile bridge approaches, they were kept as close to the permanent bridge as possible, another reason why the trestle was pushed out of line.

The river was very narrow at this point and it was necessarly to dredge about 6,000 cubic yards of the mud out of the center of the river, which was taken away in scows and dumped along the shore. Then the material for the approaches was dumped at both ends, as shown in the lower photograph of the first group, and picked up by the No. 4 dredge and placed on the approaches as they settled, as shown in the upper photograph. A smaller dredge was used on the up-stream side of the bridge to excavate and throw onto the bank material displaced by the approach fills. The bottom was disturbed so greatly that the whole channel was changed by the continual movement. About 30,000 cubic yards were placed in both shore ends of the approach fills. The pile bridge displaced by the movements of fills and bottom was rebuilt in the original position and four 20-inch I-beams, about 25 feet long, were placed in it to provide a place for taking out the smaller dredge when its work was finished.

The borrow pits for the filling required were within 300 feet of the Quincy approach to the river, which was about the center of the work. At the close of last season's work all the grading had been completed and about 120,000 cubic yards of filling material had been put in place. The final touches on the fills and the slope-paving work have been completed this



PLACING MATERIAL IN FILL ACROSS TIDE FLATS.

ABOVE: Dredge rehandling dumped material and placing it on the settling fill.

BELOW: Train of cars dumping first part of fill from trestle down its center.

QUINCY SHORE BOULEVARD. FILLS THRU LOW AREAS AND ALONG BANKS OF POND.

spring, the latter being the rip-rap of the bid prices above, and consisting of the paving of the slopes of the bridge approaches with large flat stones about 12 inches thick, with the joints filled with cement mortar. During the best months of last season the contractor operated day and night gangs which placed about 1,500 cubic yards a day, with a maximum of 2,000 cubic yards, very satisfactory progress in view of the depth of the fill.

Quincy Shore Boulevard, Cut at Sailors' Home Hill.

Above: Rough grade turned over to traffic

Below: Finished grade with lawns graded and lamps installed, ready for boulevard surfacing by future contract.

The second group of photographs shows two views along the river, called Black's creek, after completion to sub-grade.

The third group of photographs shows two views of the large cut made at the Sailors' Home hill, one when the grade had been completed and the other when it had been more thoroly smoothed up and lamps placed. About 30,000 cubic yards of material was taken out of this cut and placed on fills elsewhere on the work. The hill on the right shows the original surface of the ground. Traffic was let on this sub-grade as soon as it was completed, the bottom being of good gravel, excellent to travel over. The only preparation for the travel was to rake off surplus stone and run a 2-horse roller over the roadway. The lower photograph shows the effect of traffic on the roadway.

The plant used on the road work consisted of a No. 20 Marion shovel, twelve 3-yard Kilbourne & Jacobs dump cars; eighteen 4-yard Western dump cars, a 20-ton Baldwin locomotive and an 18-ton American locomotive. After about a month at the beginning of the work, a Western Wheeled Scraper Co.'s spreader car was installed, relieving labor hire. A train of 18 cars was run out on the dump and the spare engine hooked onto the spreader car and graded the material to a level about 4 inches below the top of the rail. The spreader could be lowered or raised as desired. This made a great saving over the continual shoveling of the berms left by dumping the material from the dump cars.

The whole of the roadway will be covered with a permanent boulevard superstructure this season.

John Cashman & Sons Co. were the contractors on the work and it was under the direct supervision of C. J. Gilfillan. We are indebted to the courtesy of David J. White, manager of the company, for the data and illustrations of this article.

Civic Beauty in a Sewage Disposal Plant. Designed by Alexander Potter, C. E.

RECENT DEVELOPMENTS IN BITUMINOUS PAVEMENTS

BOTH BITUMINOUS MACADAM AND BITUMINOUS CEMENT

By Arthur H. Blanchard, M. Am. Soc. C. E.,
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The author of this paper has been laboring diligently to reduce to some system the methods of construction and the nomenclature of bituminous pavements, of which there are many varieties aside from the asphalt pavement, which has been fully standardized. He outlined the difficulties and his methods of classification in an address before the Canadian Good Roads Congress so clearly that his plan is printed in the hope that it will hasten standardization in a field where practice is now very far from uniform.

BEFORE proceding with the discussion of the many improvements in the construction of bituminous macadam and bituminous concrete pavements which have been developed during the period from 1914 to 1916, it is advisable, in order to avoid misunderstandings, to quote the definitions of the two types of pavements as recommended by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers.

"Bituminous Macadam Pavement. One having a wearing course of macadam with the interstices filled by penetration methods with a bituminous binder."

"Bituminous Concrete Pavement. One composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods."

General.

Certain developments which are common to both classes of bituminous pavements will be discussed prior to considering improvements which specifically refer to each of the several types.

Foundations. There has been a general acknowledgement of the ultimate economy of constructing adequate foundations to support the amount and character of traffic which the several types of bituminous pavements are able to carry. In the case of bituminous macadam pavements, this development usually has been characterized by the construction of well compacted and, in many cases, thoroly filled broken stone foundations. In the case of bituminous concrete pavements, due to numerous failures which have occurred where this type of pavement has been built on old macadam or poorly constructed broken stone foundations, there has been a general tendency to advocate the use of cement-concrete foundations from four to six inches in thickness. It has generally been found that the cost of cement-concrete foundations does not exceed the cost of well compacted and filled broken stone foundations of equivalent strength. Furthermore the use of cement-concrete foundations renders repairs and renewals more satisfactory and much easier of accomplishment.

Non-Bituminous Highway Materials. There has been a general recognition since 1914 of the desirability of covering in specifications in more detail and with greater rigidity the physical properties of the aggregates to be employed and the sizes of the particles which compose such aggregates. For example, the 1914 Specifications of the American Society of Municipal Improvements covering bituminous macadam pavements state, with reference to the physical properties of the stone, that the rock employed must meet the following requirements:

"The broken stone shall be subjected to abrasion tests and toughness tests conducted by the Engineer in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the first and second courses shall show a French coefficient of wear of not less than 7.0 and its toughness shall be not less than 6.0. The broken stone used for the construction of the third course and for the first and second applications of No. 1 broken stone shall show a French coefficient of wear of not less than 11.0 and its toughness shall not be less than 13.0."

The necessity for more carefully drawn specifications covering the sizes of the particles of which a given product of a stone crushing and screening plant is composed is illustrated by the following mechanical analysis of two products obtained from the same plant, both of which products passed over a section of a rotary screen having circular holes of 1¼ inches and thru a section of a rotary screen having circular holes 2¼ inches in diameter.

	Sample "A"	Sample "B"
Passing ¼ inch screen	0.2%	0.1%
Passing ½ inch screen	0.1	0.1
Passing ½ inch screen	0.4	1.1
Passing ¾ inch screen	2.2	12.6
Passing 1 inch screen	8.0	37.5
Passing 1¼ inch screen	29.1	40.9
Passing 1½ inch screen	27.1	7.7
Passing 2 inch screen	32.9	0.0
	100.0%	100.0%

It is hence obvious that for many forms of bituminous construction, in order to secure successful results, greater care must be used in the writing of specifications for products of broken stone. As an illustration of an improvement in specifications covering this detail, there is cited those adopted at the 1915 Convention of the American Society of Municipal Improvements covering broken stone to be used for the aggregate of one type of bituminous concrete pavement.

"Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1¼) inch screen; not more than ten (10) percent nor less than one (1) percent shall be retained upon a one (1) inch screen; not more than ten (10) percent nor less than three (3) percent shall pass a one-quarter (¼) inch screen."

It is noted that in this form of specification an attempt is made to cover in the mechanical analysis only the limits of the smallest and largest particles. No attempt is made to secure

a carefully graded aggregate but simply a product suitable for the type of pavement in question and uniform in character. For example, the following mechanical analyses show three products used in the successful construction of three different bituminous concrete pavements of the type mentioned.

	Sample "A"	Sample "B"	Sample "C"
Passing ¼ inch screen....	1.2%	2.7%	1.0%
Passing ½ inch screen	4.2	5.6	2.5
Passing ½ inch screen....	34.7	45.0	30.8
Passing ¾ inch screen....	40.6	35.1	34.2
Passing 1 inch screen....	17.3	10.1	23.4
Passing 1½ inch screen....	2.0	1.5	8.1
	100.0%	100.0%	100.0%

Bituminous Materials. There has recently been considerable discussion pertaining to the advisability of the adoption of so-called "alternate type" specifications in preference to the so-called "blanket" specifications for bituminous materials. By alternate type specifications is meant a series of specifications, each of which covers the physical and chemical properties of the most desirable grade of a given type of bituminous cement for the purposes for which it is to be used. On the other hand a blanket specification covers in one set of requirements, pertaining to physical and chemical properties, all the types of bituminous cement which are to be used in connection with the construction of a given kind of pavement. For example, in the case of specifications for asphalt cement for bituminous concrete pavements, it would be desirable under alternate type specifications to have not less than five sets of physical and chemical requirements, the limits for each requirement being as narrow as the several processes of manufacture would permit, while on the other hand a blanket specification would cover with a wider range of limits the same chemical and physical properties for the five types mentioned. As an illustration will be cited the limits in the cases of Specifications "A" to "E" inclusive under the alternate type specification method for specific gravity, and the penetration at 25 degrees C. (77 degrees F.).

	"A"	"B"	"C"	"D"	"E"
Sp. Gr.	0.97 - 1.00	1.00 - 1.03	1.03 - 1.04	1.025 - 1.05	1.04 - 1.06
Penet.	75 - 90	90 - 100	70 - 90	85 - 95	140 - 160

In the case of a blanket specification to cover the same grades of the several types, the limits for specific gravity would have to be 0.97 to 1.06 and the limits for penetration would be 70 to 160. The penetration test, for example, can only be of maximum value when applied to the grade of a specific type of bituminous cement which is most suitable for the type of pavement in question. In the case of the bituminous concrete pavement of the type mentioned, the proper penetration limits for a California asphalt lie between 70 and 90 while for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, the penetration limits should be between 140 and 160. It is evident that to attempt to cover the penetration limits for both materials in one specification is impracticable. In the first place such limits as 70 to 160 are so wide as to insure but little uniformity in different lots of the same material and in the second place an entirely unsuitable material of one class could be supplied under the maximum or minimum test limits of the other class.

The proper use of alternate type specifications allows the contractor to bid to supply so many tons of bitumen which will comply with any one of the sets of requirements. It will be noted, therefore, that the contractor is in exactly the same position as in the case when he bids to supply any asphalt cement which will comply with the requirements of a blanket specification.

Guarantees. There has been a general tendency to abandon the use of guarantees on bituminous pavements as it is believed that, with proper specifications and efficient supervision and inspection, guarantees are not necessary and that the requirement of a guarantee materially increases the prices bid on a given pavement. The subject of guarantees is too broad to discuss in this paper but it should be noted that under the title "The Economics of Guarantees of Pavements on State and Municipal Highways", it has been admirably treated by Mr. George C. Warren in a lecture in the Graduate Course in Highway Engineering at Columbia University, which lecture has been published under the auspices of the National Highways Association, Mr. Charles Henry Davis, President.

Bituminous Macadam Pavements.

In addition to the improvements noted above, the most notable recent development in the construction of bituminous macadam pavements has been in connection with the compaction of the road metal and the distribution of the bituminous materials.

As a result of the numerous failures of bituminous macadam pavements which have occurred due to the improper rolling of wearing courses of road metal prior to the application of bituminous material, there has been a general recognition of the necessity for more thoro compaction of the road metal. This principle has been recognized by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers in its 1915 Report, the conclusion referred to reading as follows:

"An important factor for successful results is the proper compaction by rolling of the road metal before the spreading of the bituminous material."

The above Committee emphasizes another improvement which is aimed at the use, in some cases, of an excess amount of bituminous cement in this type of pavement. This conclusion is as follows:

"Present indications are to the effect that the use of bituminous materials in quantities of more than 2½ gallons per square yard where the upper course of the macadam is to be 3 inches in thickness after compaction is inadvisable under the penetration method."

There has been a general recognition of the advisability of using properly designed distributers in connection with the application of bituminous materials in order to secure uniform distribution economically. Some specifications cover the requirements which a distributer must meet. For example, the 1914 Specifications of the American Society of Municipal Improvements contain the following paragraph pertaining to the pressure distributer.

"The pressure distributer employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gage so located as to be easily observed by the Engineer while walking beside the distributer. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributer shall be provided with wheels having tires each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per

linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter."

This specification provides for a distributer by which it is practicable, under competent supervision, to secure uniform aplication of the bituminous material and allows the use of a pressure distributer without danger of rutting of the wearing course of broken stone by narrow tires carrying excessive weights.

Bituminous Concrete Pavements.

The improvements in the construction of bituminous concrete pavements to which attention should be called will be considered under the following classification of the three types into which bituminous concrete pavements generally may be divided. These types are designated as follows:

(A) A bituminous concrete pavement having a mineral aggregate composed of one product of a crushing and screening plant.

(B) A bituminous concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing and screening plant and a certain number of parts by weight or volume of fine mineral matter, such as sand or stone screenings.

(C) A bituminous concrete pavement having a predetermined mechanically graded aggregate of broken stone or gravel, either alone or combined with fine mineral matter, such as sand or broken stone screenings.

Patents. Unfortunately the present status of patent litigation has to be considered in connection with the discussion of the several types of bituminous concrete pavements. The majority of engineers and highway officials are interested in the types of bituminous concrete pavements which may be constructed without danger of litigation rather than in a prolonged discussion of the probabilities of successfully defending suits for infringement. There is ample evidence at hand that bituminous concrete pavements of type (A) may be constructed without danger of litigation proceedings, provided that the mineral aggregate is of the general character heretofore mentioned in this paper under the section "General. Non-Bituminous Highway Materials."

The history of litigation cases indicates that the construction of bituminous concrete pavements of type (B) on a large scale will in all probability lead to litigation. The same remarks apply to the construction of bituminous concrete pavements of type (C), except in the case of the so-called Topeka bituminous concrete pavement with an aggregate of the type specified either in the 1910 Topeka decree, or of the grading which was adopted at the 1915 convention of the American Society of Municipal Improvements.

Type (A). Minerals. Practice has demonstrated that broken stone, because of the satisfactory mechanical bond secured, makes the most suitable aggregate for this class of bituminous concrete, altho pavements constructed with gravel have proved satisfactory for light traffic where great care has been taken in the selection of the gravel and in the construction of the pavement. The development of the character of materials used in current practice has been covered in this paper under the title "General." Much more care has been taken in recent years with reference to the quantity of bituminous cement to be used in the mix. There has been a general recognition that the amount used depends upon the kind of road metal and the bituminous material, the character of the aggregate and the climatic conditions. For the product of broken stone heretofore mentioned, it has been found that bituminous concrete mixtures should contain between 5 and 8 percent by weight of bitumen.

Mixing. Many improvements are noted in the methods employed in the mixing of bituminous concretes. There has been a general evolution from hand mixing methods to the utilization of mechanical mixers especially designed for the manufacture of this type of bituminous concrete. The large contract for 35 miles of bituminous concrete pavement of this type around the Ashokan Reservoir, constructed under the direction of the Board of Water Supply of the city of New York, demonstrated the desirability of the manufacture of a plant especially designed for this class of work. The type finally evolved showed that it is practicable and economical to use a self-propelled plant, consisting of elevators, a rotary dryer, weighing devices and a mixer, having a capacity of from 800 to 1,000 square yards of 2-inch wearing course per day. Experience has demonstrated that, except on small contracts and for repair work, mixers which provide for the heating of broken stone by the use of a flame in the chamber should not be used on account of the danger of burning the broken stone or the bituminous concrete.

Laying. There has been considerable discussion pertaining to the proper type and weight of roller to be used for the compaction of the wearing course. Experience demonstrates that in order to secure an even surface and adequate compaction by thoro interlocking of the particles of broken stone, a tandem roller weighing between 10 and 12 tons should be used.

Seal Coat. Many methods have been developed for the application of the seal coat of bituminous material. It has been found that seal coats of from $\frac{1}{2}$ to 1 gallon per square yard of bituminous cement are distributed most uniformly by the use of hand-drawn gravity distributers followed by a squeegee.

Seasonal Limitations. Experience in many localities has demonstrated that bituminous concrete of this type should not be mixed or laid when the air temperature in the shade is below 50 degrees F., as otherwise it is difficult, under average conditions, to secure an even and well-connected wearing course.

Type (B). Specifications for this type of pavement have, during recent years, generally stipulated that so many parts of broken stone and so many parts of sand or other fine material are to be mixed with a certain amount of bituminous cement. By the use of this specification, unless employed under unusual supervision, it has been found to be impracticable to secure a well-graded aggregate. In many cases the mixture has contained an excess of broken stone with insufficient fine material to fill the voids therein, while in other cases it has contained an excess of sand in which the broken stone exists as isolated particles. It is the conclusion of many engineers, because of the conditions described, that when bituminous concrete pavements are to be employed either type (A) or type (C) should be selected.

Type (C). During recent years, the bituminous concrete pavements of this type which have been most extensively employed are known as bitulithic, Warrenite and Topeka.

Bitulithic and Warrenite. Differentiation. The general use of bitulithic and Warrenite bituminous concrete pavements thruout America has brought up for discussion the matter of the fundamental differences between these two types of patented pavements. It is believed that it will be of interest and value to the engineering profession to submit the following statement, prepared by Mr. George C. Warren, president, the Warren Brothers Company, for the information of the engineers enrolled in the Graduate Course in Highway Engineering at Columbia University:

"Bitulithic and Warrenite mixtures are both made under the provisions of the Warren patents, which the courts have held 'cover the product no matter how produced.' Bitulithic is designed to meet the conditions generally prevailing on city streets, and Warrenite is to meet such conditions as may arise on country roads so as to meet the physical and economic conditions and public demands as to cost.

"Generally speaking, bitulithic is mixed by a plant which is too cumbersome to meet country road conditions, which pro-

vides for combining the materials proportioned by separation of sizes of the aggregate, after heating, and then recombining by weight.

"Warrenite is, generally speaking, mixed by a plant so portable that it may be set up either alongside the railroad, along the side of the road being constructed, or in the quarry or gravel bank from which the bulk of the aggregate is being procured, as may be most economical in any particular case. This plant is constructed on the principle of proportioning the several separated sizes by careful measurement by bulk before heating and retaining the batch so measured as a separate entity thru the process of heating and delivery into the mixer in which the bituminous cement is added.

"Generally speaking, crushed stone predominates in the fine aggregate of bitulithic, while sand predominates in the fine aggregate of Warrenite; also, fine crushed stone and sand respectively are correspondingly used for the seal coat aggregate.

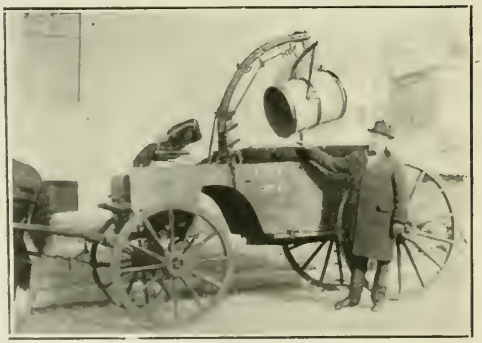
"In the selection of quality of material (whether gravel or crushed stone) for the coarse aggregate a greater latitude is permitted in the case of Warrenite to practically meet the conditions of less opportunity for selections which are liable to prevail in localities considerable distance from railroad centers. This latitude is allowed, because, while the traffic conditions on country road thorofares are in point of weight and concentration of traffic rapidly becoming fully as severe as on most city streets, there is the important difference that on country roads generally the traffic is more exclusively of the motor vehicle rubber tire type and consequently less exaction in physical properties of the quality of the stone forming the basis of the aggregate is necessary. Also, unfortunately, many city streets are abused by constant excessive sprinkling or daily scoured by pressure flushing machines, a practice which is more or less injurious to any road surface, while country roads are seldom, if ever, wet except by rainfall; therefore, in cases where the very best quality of stone is unavailable, it would be safe to use stone of slightly lower quality in Warrenite on a country road, altho the same quality stone might not be safe for use in bitulithic on a city street."

Topeka. In many specifications the mineral aggregate for the Topeka pavement specified has been that contained in the decree of 1910, namely:

"Bitumen, from 7 percent to 11 per cent.
Mineral aggregate, passing 200-mesh screen, 5 to 11 percent.
Mineral aggregate, passing 40-mesh screen, 18 to 30 percent.
Mineral aggregate, passing 10-mesh screen, 25 to 55 percent.
Mineral aggregate, passing 4-mesh screen, 8 to 22 percent.
Mineral aggregate, passing 2-mesh screen, less than 10 percent."

Many unsatisfactory pavements have resulted by the unintelligent use of this grading. It has been found necessary, in order to secure successful results, to specifically define the character of the sand or other fine material which shall be employed in order to secure a satisfactory grading. Many specifications now cover the sand grading with almost the same care as in the case of sand grading requirements for sheet asphalt pavements. In order to encourage the use of a more satisfactory grading for this type of pavement, the American Society of Municipal Improvements in 1915 recommended the adoption of the following grading:

Passing	200-mesh screen.	7 to 10 percent.
Passing	80-mesh screen, but retained on 200,	10 to 20 percent.
Passing	40-mesh screen, but retained on 80,	10 to 25 percent.
Passing	20-mesh screen, but retained on 40,	10 to 25 percent.
Passing	8-mesh screen, but retained on 20,	10 to 20 percent.
Passing	4-mesh screen, but retained on 8,	15 to 20 percent.
Passing	2-mesh screen, but retained on 4,	5 to 10 percent.



Street Cleaning Apparatus in Grand Rapids

The system used by William M. Walsh, highway commissioner, in cleaning the streets of Grand Rapids, Mich., is one of his own invention and is said by authorities to be one of the most efficient in operation.

Several features combine to make up the system, principal among them being the collection wagon. It is an ordinary base-dumping vehicle, equipped with Walsh's patent crane. Over steel pulleys a wire cable runs from a crank at the side of the wagon. The crane is swung from side to side by a lever and the arms of the yoke are hooked over the filled garbage cans, special iron hubs receiving the hooks. Turning the crank, the can is raised to a position above the wagon, where a ratchet on the crank holds it stationary. By shifting gears, the can is then dumped, when the crank tightens a second cable terminating in a steel catch, which hooks to the bottom rim of the can. Each can holds 400 pounds and is raised and emptied with ease.

Walsh has numerous collection stations, where the gangs of white wings leave the filled cans and procure empty ones. Two-wheeled carts, also designed by Walsh, are equipped with steel hooks terminating a semi-circular steel arm. The hooks fit over the iron nubs on the cans and the operator places them in position by manipulating the arm, which is held stationary by a hook fastened to the push handle.

Gangs of white wings collect the refuse in the streets with brooms and steel pans and when a can is filled it is taken to a collection station. There it is covered with a galvanized iron cover and held until a collection wagon appears. One wagon easily handles the cans deposited at a station and empties the refuse on the city dumps, where it is used to fill in low places.

QUESTION DEPARTMENT

Non-Partisan Management of Municipal Water Works

This city has just installed a gravity water works system at the expense of $400,000 and we are now concerned about divorcing the management of it from politics by the establishment of a board of a non-partisan character who will manage the works.

I would like to get information as to what other cities of this size (population 5,500) have done along this line and you can also probably cite me to some articles in your magazine which discuss such matters.

B., City Attorney.

In the city of Erie, Pa., the board of water commissioners is composed of three members with terms of three years, one being appointed each year by the Court of Common Pleas of the county, the intention being that the appointments be as far from politics as possible. This seems to be the result, and when a good man is secured he is continued for several terms. Almost every commissioner, since the beginning of the system in 1867, has served at least two terms and most of them from three to five terms. The tenure of office of the executive officers is consequently secure and appointments to the office of secretary and treasurer have been life appointments of men who have demonstrated their ability under their predecessors. The present incumbent has been in office fifteen years, following eighteen years as assistant secretary. While changes in superintendent and in engineer have been more frequent, they have been mainly because the incumbents moved on to other situations preferred by them.

Other cities have similar systems, the appointing power being selected according to local conditions and laws.

Permanency of tenure of office by the executive employes is the principal essential to secure good men and keep them and this is only secured by making the appointments for competency only and removals for political reasons impossible.

Another essential is to keep the control of the funds necessary for operating and maintenance purposes, in fact all funds, except, possibly, the authority to issue bonds, in the hands of the commission, otherwise councilmen may demand favors as the price of votes for the necessary appropriations.

Producers of Tar

We are desirous of getting some data in regard to the tar and tar producing companies who produce tar for the markets of the United States.

Would it be asking too much of you to give us the names of several of the larger companies? Also, let us know what companies produce tar for special purposes, and what they are especially used for.

J., Cincinnati, O.

All the plants producing coal gas for illumination are producers of tar, also the plants using retorts of various sorts for producing coke. Water-gas plants produce water-gas tar, which is of somewhat different constitution, and the combined coal and water-gas plants produce tar which may be a mixture of the two. A list of the gas companies in the country will be found in Brown's "Directory of American Gas Companies" ($5). It also gives the names of the companies owning more than one plant, some of which are thus large producers.

Tar is really put on the market by companies which take the tar from the various plants, refine it and put it into shape for practical use. Among the principal companies in this business are the Barrett Manufacturing Company, 17 Battery Place, New York, who produce tar for any purposes desired; Warren Brothers Company, Boston, Mass., who prepare tar largely for paving purposes, but also for other uses; Warren Chemical and Manufacturing Co., 17 Battery Place, New York; United Gas and Improvement Co., Philadelphia, Pa.; Bayway Chemical Co., Elizabeth, N. J.; Samuel Cabot, 141 Milk street, Boston, Mass.; Coal Tar Products Co., 570 Smith street, Brooklyn, N. Y.; Semet-Solvay Co., Syracuse, N. Y.; United Roofing & Mfg. Co., Morris Bldg., Philadelphia, Pa.; H. F. Watson Co., crude and refined tar, Erie, Pa.; Philip Carey Mfg. Co., Lockland, O.; Chatfield Mfg. Co., 74th and Lebanon, Carthage, Cincinnati, O.; General Roofing Mfg. Co., 17th and Southern Railway, East St. Louis, Ill.; F. J. Lewis Mfg. Co., 2513 South Robey street, Chicago, Ill. There are also some manufacturers of pine tar.

Trucks for Road Construction

I have about 18 miles of tarvia macadam and plain macadam roads to build in the next four years. At present teams are very scarce. Do you think it advisable to purchase trucks for my stone hauling? If so, what size and kind of trucks would you advise purchasing?

B., Contractor,———, Ind.

This should be the place for the economical use of motor trucks for hauling the stone and other materials. In order to choose the size and kind of truck intelligently there should be full information about the loading place for the stone, the nature of the roads over which the stone is to be hauled, as to surface and maximum grades and extent of bad stretches in them. A truck can then be chosen to suit these conditions exactly, and it would suit any similar conditions. Trucks of 3½ to 5 tons capacity seem to be most popular for such work as this but 7-ton trucks are used also, the condition of roads as stated above, governing the size very largely.

One important factor in the economy of the use of trucks is the kind of facilities for loading the trucks. They should be loaded quickly so as to lose as little time from the road as possible. Car unloaders or bins which can be filled between trips and emptied quickly into the trucks are quite necessary. The methods of dumping the stone on the road and of spreading it in the process of dumping are also of importance and will give points to consider in choosing the kind of trucks.

Many reports of the results of the use of trucks are given in MUNICIPAL ENGINEERING in the Motor Truck Section (colored insert) especially in the numbers for January, February and March, showing loads carried, speed of operation, cost of operation, and in some cases comparisons with cost of horse traction.

FIRE DEPARTMENT

Motor Fire Apparatus Costs

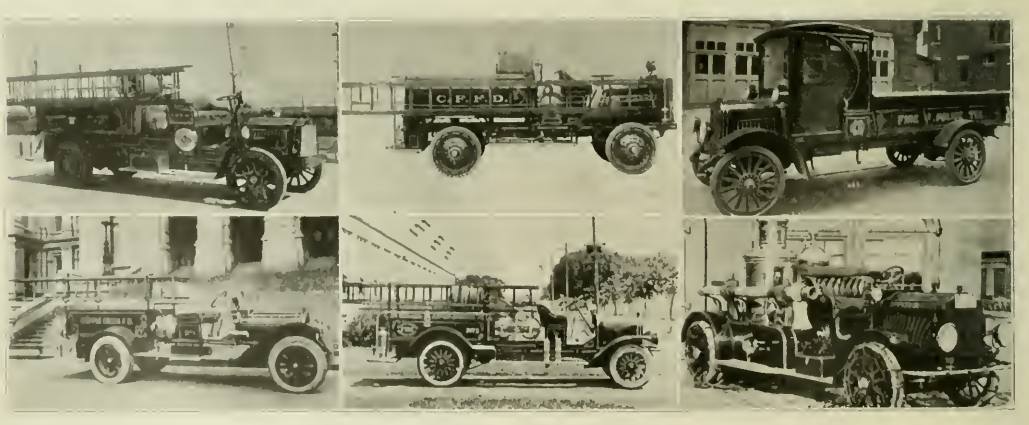
One of the most recent noteworthy fire apparatus installations, both as to chassis and paraphernalia, is found in the 6-cyl. 60-h.p. White combination installed by the city of Dover, N. J. The tank pressure is created, not by chemical action, but by an auxilliary air pressure system, consisting of a steel tank of compressed air on the left running board with a regulating valve and gage in the line between the air tank and the chemical tank. This system permits the increase of air pressure in the chemical tank in accordance with the distance the stream is to be thrown, and the air pressure also may be increased as the chemical is used. The stream, therefore, can be as powerful at the end as it was in the beginning, and it is unnecessary to refill the chemical tank when only a portion of the contents has been used.

For this class of apparatus, where seconds count in getting under way, the electrical starting system is particularly valuable. It has the usual advantage of preventing the motor from stalling at all times and without any attention on the part of the driver. Both the functions of starting and lighting are performed by one mechanism, the motor generator, which is mounted at the forward left side of the engine and driven by silent chain.

Engine Both Generator and Motor.

The entire control is centered in a single knife-blade switch located on the dash. When this switch is closed, the electric system assumes its duties and performs every function without any further attention and without the assistance of any automatic regulating devices. Both the control of the generator capacity and the change of its functions from that of a generator to a motor are accomplished entirely by the design of the unit itself. Closing the switch connects the 9-cell battery and puts the motor in operation, thus starting the engine. As soon as the latter is turning over at a speed in excess of a few hundred revolutions per minute, the generator being a slow type, the voltage of the motor generator exceeds that of the battery, and the battery is charged at all speeds above this point, at a definite governed rate. The 18-volt storage battery is "floated" on the line in such manner that the motor changes to a generator and back again to a motor, according as the electrical pressure rises or falls above or below that of the battery.

At engine speeds above a certain definite point it is a generator and below that point it becomes a motor, so that should the engine stall in traffic the electric motor will automatically pick it up and restart it without any attention on the part of the driver. It will be apparent that this should constitute



NOTEWORTHY INSTALLATIONS OF MOTOR FIRE APPARATUS.

PACKARD 2-TON CHAINLESS COMBINATION, RIVER FOREST, ILL.

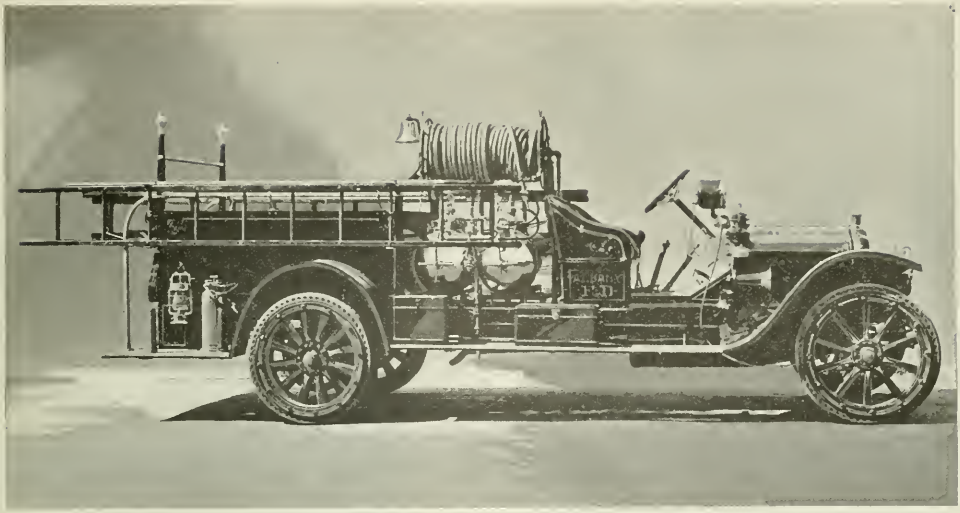
WHITE COMBINATION CHEMICAL HOSE AND LADDER TRUCK, CRIPPLE CREEK, COLO.

JEFFERY "QUAD" COMBINATION CHEMICAL HOSE AND LADDER TRUCK, CHIPPEWA FALLS, WIS.

DART COMBINATION CHEMICAL, HOSE AND LADDER TRUCK, STATE CENTER, IOWA.

SERVICE EMERGENCY FIRE TRUCK, COLUMBUS, OHIO.

ALTOONA, PA., STEAMER MOUNTED ON WHITE CHASSIS.



WHITE COMBINATION CHEMICAL AND HOSE, ALBANY, ORE.

a very valuable feature of the motive power of any piece of fire apparatus where the delay incident to having to restart the motor by hand-cranking might be serious.

Big Saving at Pontiac, Mich.

Chief J. B. Austin, Fire Dept., city of Pontiac, Mich., submits the following costs covering operation of three autos as compared with six horses:

Up-keep 6 horses (period of 12 mos.)	$941.76
Up-keep 3 autos (period of 12 mos.)	282.42
Saving in favor of autos	659.42

Following appears up-keep, or running expense, of the motor apparatus from Nov. 1, 1914, to Oct. 31, 1915:

Chief's Car:—
Ford Roadster 25-gal. chemical tank and 150 ft. hose,

Gasoline 274 gal.	$28.13
Motor oil, 19 gal.	4.35
Repairs to axle	47.90
Tire	56.69
Pres-o-Lite tank	5.25
Spark plugs	3.00
Tire chains	5.00
Traveled 1895 miles	$150.32

Answered 121 alarms.

American La France Auto Truck No. 1:—

Gasoline 152 gal.	$15.99
Motor oil 7 gal.	2.18
Repairs	1.76
Prest-o-Lite	3.00
New lighting system	13.13
Tire	66.20
Traveled 141 2-10 miles	$102.26

Answered 96 alarms.

Seagrave Auto Truck No. 2:—

Gasoline 139½ gal.	$14.88
Motor oil 10½ gal.	3.24
Repairs	4.22
Tire chains	7.50
Traveled 134 2-10 miles	$29.84

Answered 50 alarms.

Cost of Four Units Lumped.

The following costs, submitted by Chief Hugh Montgomery, Fire Dept., Houston Heights, Tex., cover the up-keep on one Federal service truck; one Ford chief's car; one Pierce-Arrow hose wagon; one Robinson hose wagon, for a period of one year. In other words the entire cost of maintaining these four pieces for a period of one year is as follows:

Cost of repairs, including labor and material	$140.00
Cost of gasoline	80.15
Cost of oil	4.50
Cost of grease	2.20
Miscellaneous expense	105.00
Total cost	$431.85

Distance traveled, 302 miles each.
Number of alarms answered 144.

Big Snows and Heavy Grades.

Chief Charles H. Gunn, Fire Dept., Cripple Creek, Colo., writes us as follows:—

"Some of our hills have 25 per cent. grades but our White Combination makes the Third street hill (20 to 25 per cent. grade) in deep snow. To negotiate the hill at high speed in good weather when the road is in fair shape is a task which would be highly creditable to motor apparatus, but on one occasion there was 18 inches of snow and the truck was forced to break its own road. Considering also that the average elevation is about 9,000 feet and that many of the runs of the fire department are hilly, the work of our truck firmly convinced the municipal authorities that the motor combination truck was far superior to the horse unit. The 60-h. p. White engine gives ample power for the steepest grades in Cripple Creek and is capable of propelling the truck faster than it is practical to drive it on most of the streets. The principal equipment consists of a large chemical tank and two portable tanks, extension and scaling ladders, hose, nozzles, and the customary paraphernalia of axes, lanterns, hooks, crowbars, etc.

Chief William Wessel, Fire Dept., Imperial City, Cal, submits the following record covering the up-keep on a Federal combination chemical and hose wagon, for a period of one year:—

Cost of repairs, including labor and material	(None)
Cost of gasoline	$30.00
Cost of oil	4.00
Cost of grease	15.00
Miscellaneous expense	(None)
Total cost	$49.00

Distance traveled, 500 miles.
Number of alarms answered, 26.

Low Cost for Four Years.

Chief J. S. Hynes, Fire Dept., Grand Junction, Colo., submits the following combined costs of one Seagrave and one Thomas Combination for period from June 1, 1911, to March 1, 1916:—

Cost of repairs, including labor and material	$130.00
Cost of gasoline	142.50
Cost of oil	18.75
Cost of grease	5.00
Miscellaneous expense	50.00
Total cost	$346.25

Distance traveled, 357 miles. Cost per mile.....$1.00
Number of alarms answered, 242.

"One hose wagon, with team," states Chief Hynes, "costs us annually more than the combined up-keep on two motor pieces for a period of four years and eight months."

Horse Cost $15.00 Per Month.

"Motor fire apparatus," states Chief Daniels, Fire Dept., Columbus, O., "costs about one-fourth as much to maintain as horse-drawn apparatus. Horses eat every day the whole year round, while the motors consume only a few gallons of gasoline when in service and none at all while waiting for calls in the houses. It costs $15 a month to keep a horse; with 130 of them in the department, this used to run into a big sum."

The motorization of the department at Columbus, O., began three years ago, when three of the outlying houses were furnished with motor trucks, and 13 of the 17 engine houses of the city are now motorized. The new trucks are costing the city from $4,000 to $10,000 each, and about $100,000 worth of such equipment is now in use. The old steamers are being retained, and will be pulled to fires as trailers on the hose trucks. Later, it is expected, the city will purchase motor pumps. While the new apparatus can make a speed of 40 or 50 miles an hour, it is not necessary, says Chief Daniels, to go faster than 20 or 25 miles an hour.

"Motor vs. Horse" in Des Moines.

Chief Will Bennett, Fire Dept., Des Moines, Ia., submits the following comparative costs covering up-keep on combination chemical and hose units, same make, one motor and one horse-drawn for same period, 1915:—

Motor apparatus:

Cost of repairs, including labor and material	$100.00
Cost of gasoline	30.00
Cost of oil	8.00
Cost of grease	1.00
Miscellaneous expense	11.00
	$150.00

Distance traveled, 332 miles. Cost per mile.....$0.45
Number alarms answered, 79.

Horse-drawn apparatus:

Cost of repairs, including labor and material	$ 25.00
Cost of feed	187.00
Cost of shoes	36.00
Harness repairs	2.00
	$250.00

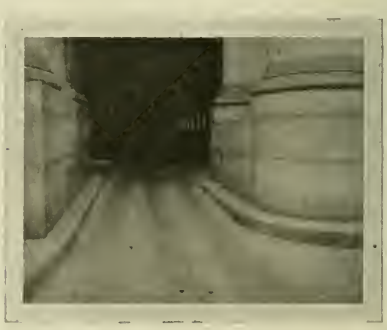
Distance traveled, 59 miles. Cost per mile.....$4.22
Number of alarms answered, 69.

Monolithic Brick Pavement in Pennsylvania Terminal

We are showing two views of monolithic brick pavement construction as laid in and about the Pennsylvania railroad terminal in New York City.

This pavement has been down for a period of five years, is laid on a sand-cement mortar bed and is separated from the sheet asphalt paving of Seventh avenue by a steel protection plate.

In spite of the heavy traffic entering and leaving the station, there has been no breaking down of the brick pavement at its intersection with the sheet asphalt. Even at the points where the traffic is most heavily concentrated, at the entrances between the columns, the bricks have only worn to a smooth surface. No cracks of any sort have developed with the exception of one across the front of the north entrance to the station, which was caused by a settlement due to the excavation of the street for the Seventh avenue subway.



Shortage of Paper

The shortage of paper is so pressing that the U. S. Department of Commerce has issued a bulletin for posting, asking everyone to save waste paper and rags until the usual sources of paper-making materials are again available.

ROADS AND PAVEMENTS

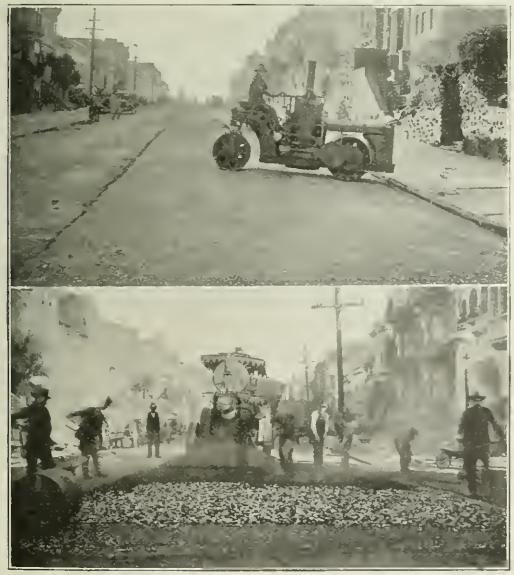
Reducing Slippery Pavements in San Francisco

By D. J. McCoy, Superintendent of Street Repair Department

The following relates to improvements in street or road pavements and the objects of the invention are to provide a street or road pavement which will prevent skidding, and also to provide an improved process of making the same.

In the accompanying photograph is a perspective view of a street in the process of construction according to my invention.

The preferred process of making my improved street or road pavement is to spread evenly, upon a suitable level foundation, to a depth of not less than one and not more than two inches, hot asphaltum, in pulverulent or granular form, heated by any suitable heating means. The foundation is also to be heated, if it is old asphaltic pavement. I next distribute evenly, thru the layer of asphaltum thus spread over the foundation, clean sharp rock broken to a size of not more than two inches and not less than one-quarter of an inch, preferably not less than one-half of an inch, and heated to a temperature not less than the temperature of the asphaltum. I then roll the asphaltum and rock together with a heavy roller, the result of which is to force the rock down into the asphaltum until the upper surfaces of the pieces of broken rock are level with the rolled layer of asphaltum. The larger pieces will be pressed down so that their lower points or surfaces may be driven into the foundation beneath.



TOP VIEW SHOWS A FINISHED SURFACE; HLF OF STREET RESURFACED WITH ASPHALT AND ROCK.

BOTTOM VIEW SHOWS METHOD OF RENDERING ASPHALT WEARING SURFACE "NON-SKID" BY HEATING STREET WITH A LUTZ SURFACE HEATER. ROCK IS ROLLED WHILE SURFACE IS STILL HOT.

No Round Surfaces.

The result is a pavement consisting principally of asphaltum and having interspread therein pieces of rock varying sizes and presenting no round or water-worn surfaces. I have found that gravel is unsuitable for such a pavement on account of the round water-worn surfaces of the gravel not offering sufficient resistance to skidding. The rough surfaces of the broken rock on the other hand offer great resistance to skidding and this is also increased by the fact that there are slight crevices between the rock and the surrounding asphalt, into which the rubber tires can enter and hold the wheel against the skidding.

The heating of the broken rock to a temperature as high as that of the asphaltum is an important feature. But for this step of the process, the asphaltum immediately surrounding the pieces of broken rock would be chilled and become hard and could not be made, by the operating and rolling, to bind around the pieces of broken rock, as effectively as with my improved process.

I have found that a pavement of this construction is very effective in preventing skidding, while at the same time the surface is free from projections sufficiently high to create any impediment to rapid traveling.

An important advantage of my invention is its comparative cheapness, as the rock and asphaltum do not, as with pavements now ordinarily laid down, have to be mixed together in the factory before being brought out to the place where they are to be used.

Resurfacing of Asphalt.

The method of smoothing up a wavy asphalt pavement was introduced into San Francisco during the month of January, 1913. The first Lutz machine was leased by the city on January 17th, 1913. On April 24th a second Lutz machine was received and on September 11th two others. Three of the machines have been working almost continuously since the above date. Although, owing to various reasons, a small percentage of the area covered has not been up to standard, the greater percentage has been entirely satisfactory, particularly the work done during the past fiscal year.

A total of 171 blocks of asphalt pavement has been resurfaced, which in square feet amounts to 2,669,371. The cost

of the work including overhead, repairs, royalty, etc., has amounted to 4.8 cents per square foot.

The leased price of each machine is $1,800.00 with the understanding that a minimum of 90,000 square feet per year must be performed. This amounts to $500.00 in royalty.

The average force required to operate one machine is one foreman, two engineers, fourteen laborers.

The operation of two machines working together requires one foreman, three engineers, eighteen laborers.

The average day's work for the entire year for the three machines has been 10,300 square feet.

Each machine carries a hood with a heating surface of 60 square feet. The heat from an oil flame is transmitted to the hood by means of a baffle wall and is evenly distributed. The hood is dropped to the surface and the pavement given a slow heat. This softens the asphalt so that the surface can be made uniformly rough by means of hoes especially cut for that that purpose. A thin layer of new asphalt wearing surface is then spread and raked over the heated surface and a 5-ton steam roller sent on to it immediately. By this method the bond between the old and new surface is perfect, numerous tests failing to show where the two surfaces come together.

Expansion Joints for Brick Pavements

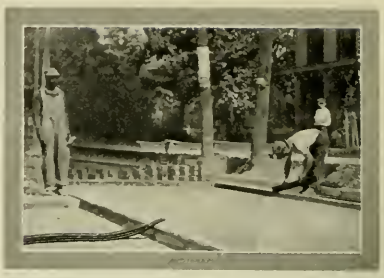
By H. C. Innes, Consulting Engineer, Cincinnati, O.

Small important details omitted in paving practice, have frequently caused damage to or deterioration of excellent materials and usually such omission or neglect is responsible for many of the criticisms pointed toward a material which does not show on the surface the best appearance. Each of the several steps taken in the construction of a brick wearing surface, and the various products or materials forming the finished pavement are essential, and must have the best of attention afforded to secure the good results desired.

The material occupying the smallest space in a brick street is the expansion joint. In cost, it is likewise the cheapest material in place, and for this reason can be looked upon as the most insignificant part of the roadway, yet this expansion joint area performs a most important function in the success of that pavement.

Progressive steps in the construction of a brick pavement, both as to material and method, as compared with the earlier practice, have done much toward perfecting this class of wearing surfaces for our city streets and country roadways; the dampened and hand-rolled sand cushion versus the merely luted cushion; the carefully mixed and placed strong grout filler for full depth versus the sand or soft filler, and lastly the prepared, preformed expansion joint for full depth and width versus the poured, unknown depth and irregular width of the joint.

The preformed joint, ready to place in position along the curb or gutter, insures a convenience to the contractor, a factor of safety in several ways for the engineer, and provides



the correct width with the full depth so essential for a hard surface pavement which is acted upon by heat, cold and moisture.

Its entrance as a material for paving work has seemingly perfected and improved the general method of construction; some of the advantages gained being a regular full width and depth of joint, the avoidance of any hard foreign material entering the joint space, which would tend to destroy the object of an expansion joint. The fact that it is placed in position ahead of the laying of the brick shortens the time for the completion and final acceptance of the contract by the officals. It avoids going back pulling strips, resetting the strips, cleaning out the joint space, heating and pouring hot bituminous material, etc., as compared with the former practice of pouring. No small plant equipment is needed or capital invested for the outfit. Being in unit form, should occasion arise during maintenance of the surface, the old joint can be removed and replaced with new sections.

Practical experience has demonstrated that the size of expansion joints for best results is obtained by placing along each curb a one-half inch joint for street widths less than 20 feet, three-fourths inch each side for streets 20 to 30 feet wide and one inch for widths of roadways greater than 30 feet, all for full depth of the brick.

The preformed type of expansion joints and the above sizes have the endorsement and approval of those most interested in the success of brick paving, namely, the National Paving Brick Manufacturers Association, as mentioned in the new specifications.

Roller Heater Melts Snow to Permit Finishing Asphalt Macadam

The heater shown in the accompanying photographs was used last December by Jno. A. McGarry & Co., of Chicago, to finish up 5,400 square yards out of a total of 63,000 square yards of asphalt penetration work in Glencoe, Ills.

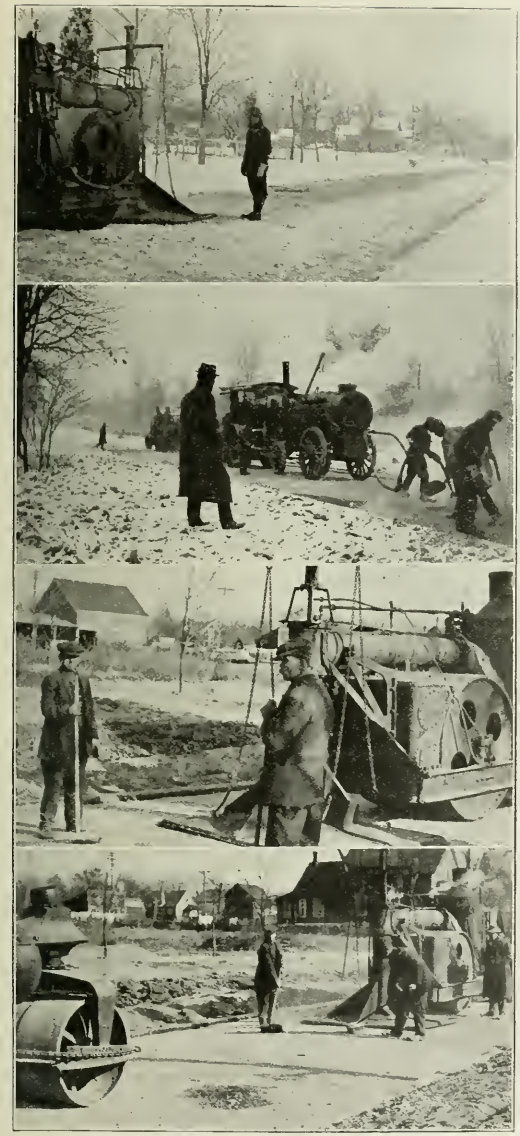
The two-inch stone wearing surface was already spread ready for pouring when it was covered by four inches of snow. The main part of the snow was moved by hand at a

a total cost of	$17.00
Rent of Barber heater four days at $20.00	80.00
Engineer at $6.50 (including car fare) four days	26.00
Helper at $3.50, four days	14.00
Pocahontas coal, one-half ton a day, four days, at $6.25, delivered	12.50
Total	$149.50

This amounts to nearly 3 cents per square yard.

This type of heater was made from an 8-ton roller, the special flue being mounted on it to carry the flue gases over the top and down to the 5 ft. by 7 ft. hood.

The heater melted the snow and warmed the road surface with a hot blast at high temperature and made possible the sat-



(1) Shows the road with the heavy snow shoveled off by hand and the track of the heater where it has done its work on half the street.

(2) This shows the heater working ahead of the asphalt pouring gang. Gang working at half speed, 1,500 yards a day, as against 3,000 in warmer weather.

(3) Near view of heater, showing draft pipe and hood. The chains are used for lifting the hood off the ground when moving.

(4) This view shows the heater going over the bad places, sweating up the asphalt for patching.

isfactory completion of the asphalt work at a comparatively low cost.

The two inches of crushed stone for the wearing surface was already in place on the concrete base when the snow came. It was decided to make an effort to remove the snow, heat the stone and finish the pouring before winter set in. For this purpose gasoline, hand-propelled road heaters were thought of, but proved to be too costly and slow for this particular work. However the contractor set a crew to work which removed the heavy part of the snow with brooms and shovels at a cost of $17.00.

Then a Barber heater, with a patching hood, was hired at $20.00 a day. The engineer received $6.50 and his helper $3.50 a day, including car fare. Pocahonatas coal at $6.25 per ton, delivered, was used and about half a ton a day was necessary for this work. The heater consisted of an 8-ton tandem roller, rigged up with a special flue leading from the boiler over the top and down to a 5 by 7 ft. hood which could be lowered till flush with the pavement. The flue gases were blown thru by a forced draft, to the hood, where they were disseminated over the roadway at a high temperature. This melted the snow and frost and heated the stone, and the asphalt was then poured immediately before the stone became cold. Heated chips were used to fill the voids in the first course and also on the top of the dressing.

We are indebted to J. T. Child, Winnetka, Ill., for this information.

The Glutrin-Bound Macadam Highway

By C. J. Knisely, Formerly Division Engineer, Ohio State Highway Department, before the Ohio Engineering Society.

The ideal binder and preservative for a macadam road is some cementing material that will bind the aggregate firmly together, that will render the metal practically waterproof, form a stable surface and yet not destroy the elasticity and resilience of the mass. A binder that will protect the surface from the disrupting strains to which the road is likely to be subjected and at the same time will be reasonably low in first cost and economical to maintain.

The alinement, grade, earthwork, drainage, culverts and bridges of certain kinds, may be regarded as permanent parts of a road, but most of these will not remain permanent unless protected by a proper wearing surface. There is no such thing as a permanent road surface. Traffic and disintegration from natural causes render any road surface subject to repair or renewal at some time or other, and adequate provision should be made for such repair and renewals as the same may become necessary.

Some types of pavement may be cheaper than others in first cost, but their life may be shorter, or the annual expense of maintaining them greater. In other types the first cost may be excessive, which again renders the annual cost great, due to the annual interest charge upon the cost. The annual interest charge on the difference in cost may be greater than the annual cost of the maintenance of the cheaper type.

Most engineers are too prone to build expensive roads. They like to see what they term a finished product. It is better to make an entire country accessible by building a more universal means of communication and then letting the added prosperity maintain this up to a proper standard, than to leave part of it inaccessible by building only a limited number of miles of extravagant construction. The financing of road improvements is rapidly becoming of vast importance. It necessarily involves consideration of all future operations of construction, repair and maintenance, and the repair and maintenance charges should be considered at the time of selecting the type of pavement.

In the design of a road the engineer should consider the kind, nature and action of the forces or elements which tend

RED SHALE ROAD AT PRINCETON UNIVERSITY, NEW JERSEY; PROBABLY THE FIRST SUCCESSFUL SHALE ROAD BUILT IN THAT STATE, TREATED IN 1913.

SAND-CLAY ROAD AT CHAPEL HILL, N. C., TREATED IN FEBRUARY, 1912, ON INCLINE WITH CONSIDERABLE TRAFFIC AND NO SIDE DRAINAGE, WATER RUNNING DOWN CENTER. NOTE DIFFERENCE BETWEEN TREATED STRIP IN CENTER AND UNTREATED SIDES.

WILLIMANTIC-HARTFORD GRAVEL ROAD IN CONNECTICUT. SURFACE GLUTRIN TREATMENT IN JULY, 1913. NOTE HARDNESS AND FINE CONTOUR, AS SHOWN BY THE LINE SHADOWS ACROSS IT.

CHICAGO ROAD NEAR LAPORTE, IND. A BADLY RUTTED, RAVELED AND DUSTY MACADAM ROAD WAS TREATED WITH GLUTRIN IN SUMMER OF 1913 AT A LABOR COST OF ABOUT $12 A MILE, WITH THE EXCELLENT RESULT SHOWN, THE DUST BEING MADE A PART OF THE ROAD AGAIN.

to disrupt or disintegrate the road surface, and then select those materials and methods of construction, consistent with economy, which will best serve to counteract those forces.

The first essential is thoro drainage. The second is a firm, smooth, compacted roadbed. The road should be constructed in two courses. The lower course being designed to assist in distributing the loads over a larger area of the subgrade and to support the wearing surface.

Clays and most sub-soils when thoroly saturated with moisture, become very slippery. Therefore, if a roadbed is not properly drained and the voids are not thoroly filled, the traffic on a road will force the clay up thru the stone, where it will act as a lubricant between the particles of stone and the bearing or supporting value of the road will be destroyed. When a road surface is weak from insufficient thickness or from a soft or yielding foundation, bending and cross-breaking takes place under passing loads, which breaks the bonds between the stones.

The upper course should be designed to withstand the action of the elements and the wear and tear of traffic. The durability of a road surface depends upon the power of the materials of which it is composed to resist those natural and artificial forces which tend to destroy it. The stability of a macadam road surface depends largely on the interlocking of the pieces of stone and the retention of the fine particles of dust and screenings which serve to bind together and hold in place the coarser particles of stone constituting the road surface. The more perfect the keying and interlocking of the stone, and the binding of the dust and screenings, the more rigidity. This must be accomplished by chemical or mechanical means or both.

In the construction of a glutrin-bound road, it is very essential that all the voids be thoroly filled with screenings and fine dust, as the fine particles and screenings very materially assist in holding the larger fragments in place, and are also more readily acted upon by the glutrin. If the voids are not thoroly filled when the glutrin is applied, the road will act like a sieve and the glutrin will filter thru it before there is any action or set produced by it. Glutrin produces a firm, hard surface but has sufficient resilience and elasticity to withstand the strains due to changes in temperature without cracking.

There are in general use four different methods of binding the stone which forms the road surface. The first consists in keying and interlocking the stone by rolling and adding dust and screenings and flushing them into the voids. This forms a mechanical bond which assists in holding the pieces of stone in place. The second consists in adding to the stone or aggregate, a binder such as bitumen, the resulting bond being due to the adhesive action of the bitumen itself. The third consists of forming a bond between the various particles of aggregate by adding a material such as portland cement. When water is added to portland cement the active element of the portland cement immediately goes into solution, after which a precipitate is formed, consisting of crystals which in hardening adhere to the various fragments, thus binding them together. The precipitate which forms and hardens is the result of a chemical union between the cement and water, for the cement alone will not harden, unless molsture is added to it, nor has water itself any cementitious or binding properties. The fourth consists in using a material such as glutrin, and combining all three of the foregoing methods. In the process of laying, glutrin takes advantage of the mechanical action due to the interlocking of the stone, and it also has an adhesive

action similar to that of tar or asphalt, and a binding action like that obtained by the use of portland cement.

It has long been known that simple moisture has the effect of leaching out of road materials certain natural binders, chemically effecting a union between the particles of stone. A bond is developed by hydrolizing some of the rock components, which results in the formation of colloids. Water containing small amounts of carbonic, humus or other acids, is capable of slowly decomposing many materials commonly found in rocks used in road building. Water alone is capable of acting chemically upon many rock constituents, causing a breaking down into secondary products of the primary minerals. This is the principle underlying waterbound road construction and supplies what is known as the bond of a road. The chemical action acts in binding the road surface by the formation thru solution and evaporation of crystal bodies which upon crystallization forms a more or less rigid bond. The effect of glutrin is to intensify this leaching and hydrolizing action thereby greatly increasing the quantity and quality of the natural binder brought out of the road metal.

When glutrin is added to a road surface which is composed of limestone, silica and alumina, an action similar to that of portland cement takes place, altho its action is slower, producing a series of chemical compounds which flow out into the space between the stones and crystallize in very much the same manner as cement, forming a bond which is insoluble in water and which is not affected by changes in temperature.

Glutrin is not the only substance that acts chemically when applied to a road surface, as sodium silicate, commonly known as water glass, and having the formula $Na_2 SiO_3$, upon exposure to the air or to carbonic acid gas, precipitates gelatinous silicic acid from its solution, which when applied with some basic material, such as ilmestone, makes an excellent binding material. Sodium silicate may be applied in solution. From solutions of metallic salts, sodium silicate precipitates insoluble colloidal silicates of the metals.

The life of a glutrin road is dependent largely upon the aggregate used and the methods employed in the construction. As long as there is moisture present, the production of the chemical bond continues and when the road becomes dry the bonding medium created by the action of glutrin hardens and becomes insoluble. The voids thus become so sealed that the surface thereafter absorbs but very little moisture. The adhesive action is intensified, thereby obviating all raveling of the road surface, greatly reducing the wear upon the road because of the hardness and density of the mass which it produces. Some binders produce a very rigid bond and others a more or less resilient bond. The latter is to be preferred for country highways.

Another point to be considered in the selection of a road surface for country highways is that the traffic confines itself to about three-fourths of the width of the road. Where the traffic is heavy or concentrated, there is a marked tendency for bituminous macadam of the penetration type to squeeze out, forming broad depressions, holes and ruts, owing to the bitumen possessing very little inherent strength to resist shear and compression. These depressions will eventually become deep enough to collect debris and hold water which will hasten the deterioration of the road. On city and village streets this tendency is not so great, as the traffic must necessarily be well distributed over the surface and in diagonal directions because of the constant passing of the various vehicles. The problems involved in the construction and maintenance of country highways, therefore, differ very materially from those which are encountered in the improvement and maintenance of city streets. Hence, the materials and methods of construction which have proven satisfactory for city and village streets, often prove dismal failures in country highway construction.

The object of a surface treatment is to prevent the formation of dust, the loss of the fine particles and the displacement of the coarse aggregate. A clean, practically dustless surface is the first requisite of any form of surface treatment; since it is not the purpose of a surface treatment to lay any quantity of dust which may be present on the road, but to prevent the formation of dust. Many so-called road binders are essentially lubricants and when put on a road surface in any considerable amount will disintegrate the road surface instead of binding it. It is very desirable and important that the surfacing material penetrate the surface of the road to a small extent.

A difficulty with most surface treatments is that they form a mat or carpet coat on the road surface which does not adhere to the road metal. This mat soon breaks and peels off and instead of protecting the road surface, is a serious detriment or damage to it, as the traffic produces a hammering effect upon the road metal where the mat has been displaced, causing deep holes and ruts.

It is generally conceded that asphalt is best for surface treatment for bituminous roads. This is best evidenced by the action of the American Society of Municipal Improvements at their convention held in Dayton in October last, when they, by their action, recommended an asphalt surface for all types of bituminous road construction, whether the bonding material be of asphalt, tar or other bituminous product.

A serious objection to most binders by the penetration method is that in cold weather they become brittle and slippery, while in warm weather the road loses much of its stability due to the plastic condition of the bitumen and to the fact that the voids are mostly filled with bitumen instead of screenings and fine graduated material.

Usually the best results have been obtained by the application of cold asphalt treatments. It is advisable to wet the road and let it set until thoroly dry before application. This cleans the stone, thereby removing any film of dust and also makes the surface slightly porous. The resulting moisture induces capillary attraction and offers a better chance for the bituminous material to penetrate and adhere to the road surface.

On roads where the products of wear and dust formation are reduced to a minimum, the road may become dusty from outside sources, as no road surface will remain dustless for any considerable length of time.

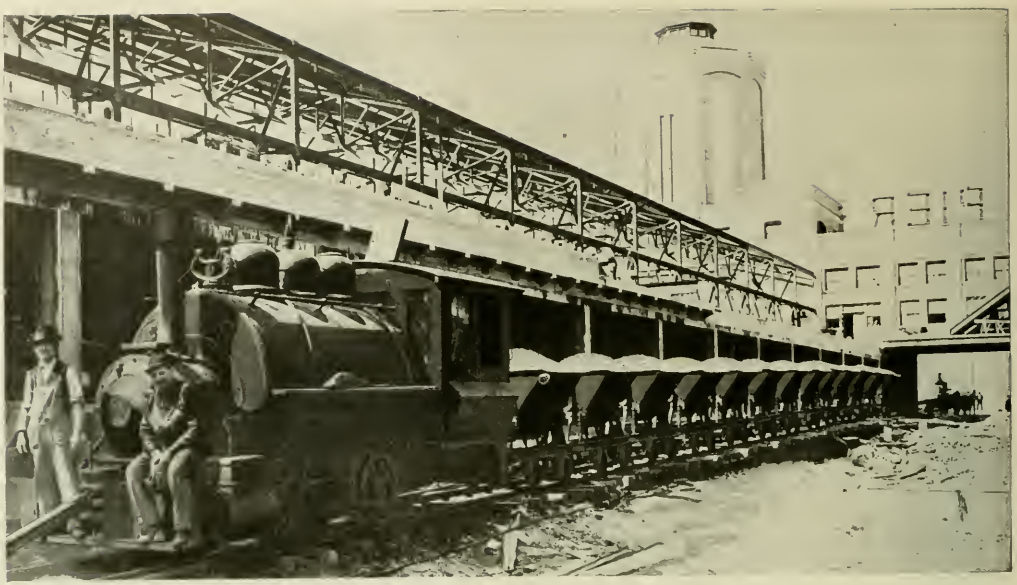
The ideal road surface for highways for cities and villages is a macadam road bound with glutrin, and treated with a light asphalt. The glutrin binds the aggregate together, forming a very stable surface. The asphalt combines with the glutrin, forming a chemical or mechanical mixture, insoluble in water and which produces a dustless surface that will not crack, break or peel off.

A glutrin macadam, properly constructed and maintained comes nearer fulfilling the ideal conditions for a street or highway than any other type. It is comparatively quiet. It has low tractive resistance. The first cost is low. It is economical to maintain. It is easy to construct and repair. It is not affected by frost, rain or wind. It affords a good foothold for horses and is not displaced by heavy loads or auto traffic. It is practically dustless and is easily cleaued. It radiates but little heat. It is pleasing to the eye and adapted to every grade.

Chicago's Municipal Pier

By L. A. Dumond.

Chicago's new recreation, or municipal pier, located on the north bank at the mouth of the river, extends for a distance of 3,000 feet into the lake. The pier proper, which is 300 feet in width, was made by constructing large concrete walls resting upon piles driven into the bed of the lake, and filling in the intervening space with sand and excavation of all kinds collected within the city.



LAKEWOOD ONE AND ONE-HALF YARD "V" DUMP CARS HAULED IN TRAINS HANDLING SAND AND CRUSHED STONE ON CHICAGO'S NEW RECREATION PIER.

Beginning at the shore end of the pier, the first building which meets the view is the head house, which is distinguished by two octagonal towers. This building will house the administrative officers, who will look after the various municipal and commercial interests making use of the pier.

From the head house to the terminal building, 2,340 feet in length, stretch two freight and passenger buildings with an 80-foot roadway in the center.

The first floor of these buildings, which are 2-story structures, will be devoted to the handling of the freight and package business carried on by the many steamship lines entering the port of Chicago. The roadway, already mentioned, will permit freight to be loaded and unloaded but a short distance from the boats docked at the pier and on a level with this floor. The floor for freight handling in each of these buildings is 100 feet in width, with 6-foot docks for loading purposes.

The second floor of these buildings is designed to accommodate the passenger service of large excursion or passenger boats. Passengers may embark directly from this floor upon the boats. The floor is 67 feet in width, with 16-foot passageways upon the outer side of each building.

Office space is also provided upon the second floor ample for all steamship lines making use of the freight and passenger facilities offered at the pier.

Street cars from the Grand avenue line enter the buildings upon the level of the second floor, running adjacent to the inner edge of this floor and extending thruout the entire length of the buildings with a return loop to the city.

Above the roof of the freight and passenger buildings and surrounding the same on the outer side is a railroad promenade 14 feet in width, which extends past the terminal building and above the roofed shelter, to the concert and dance hall located at the extreme end of the pier.

In the space between the terminal building and the concert and dance hall, about 115 feet in length, is provided a 2-story roofed shelter open at the sides. This space is for the exclusive use of the public for recreational purposes and will be available for use day and night. The immense shelter will be equipped with tables and chairs, and will really constitute two large roof gardens where one may rest and recuperate in the cool of the lake, removed from the rush and roar of Chicago's busy center. It is intended that no charge shall be made for its use.

This municipal auditorium has a floor space of 18,000 square feet, and is provided with a stage suitable for dramatic entertainments, band concerts and like functions. The hall will seat about 4,000 people, and can be used for small conventions, public meetings, etc. It will also provide an ideal place for the holding of dances. The present intention is to make no charge to the public for its use.

In addition to the civic and commercial functions which will be served by the new pier, the government has found it to be a good location for a signal station, which it has built at the extreme eastern end and is now operating.

The municipal pier, when completed, will represent an expenditure of about $4,600,000, all of which has been provided by a bond issue voted by the people of Chicago. It is estimated that the income from the rental of space in the freight and passenger buildings and the other concessions will pay for the maintenance of all the buildings, amortize the original cost and pay 1 per cent. on the investment.

The pier is well protected by a government breakwater on the north side. A small gap in this breakwater is now being closed. To add to its safety in time of a storm, a breakwater is now under construction south of the mouth of the river. This breakwater now extends to about the foot of Randolph street. A government appropriation is assured, which will enable the breakwater to be extended as far south as Adams street.

MISCELLANEOUS

The March of Events

June 3. The Municipal Engineers of the City of New York have the unusual privilege of inspection of the fortifications at Sandy Hook.

June 5-7, at Cleveland, O., National Conference on City Planning. Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass.

June 13, 14, at Ogden, Utah, Intermountain Good Roads Association. O. J. Stillwell, secretary, Ogden, Utah.

June 5-9, at New York City. American Water Works Association. J. M. Diven, secretary, 47 State street, Troy, N. Y.

June 6-9, at Newark, N. J., International Association of Chiefs of Police. Chas. Kiser, secretary, Norfolk, Va.

June 14-17, at Cleveland, O., American Institute of Chemical Engineers. I. C. Olsen, secretary, Cooper Union, New York City.

June 15. The Municipal Engineers of the City of New York, The Brooklyn Engineers' Club and The American Society of Mechanical Engineers will spend the evening on the steamer Mandalay on the Hudson river, with a moonlight sail and dance.

June 21-23, at Isle of Pines, S. C., Tri-State Water and Light Association of the Carolinas and Georgia. W. F. Stieglitz, secretary, Columbia, S. C.

June 25-30, at Philadelphia, Pa., Associated Advertising Clubs of the World. P. S. Florea, secretary, 803 Merchants Bank building, Indianapolis, Ind.

June 29, at Chicago, Ill., National Gas Engine Association. H. R. Brate, secretary, Lakemont, N. Y.

June 27-30, at Pittsburg, Pa., American Society of Civil Engineers. Charles Warren Hunt, secretary, 220 West 57th street, New York City.

June 27-30, at Atlantic City, N. J., American Society for Testing Materials. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Pa.

June 19-22, at Pittsburg, Pa., Society for the Promotion of Engineering Education. F. L. Bishop, secretary, University of Pittsburg, Pittsburg, Pa.

June 20-22, at Wilmington, N. C., North Carolina Good Roads Association. Dr. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

Sept. 4-8, at Lexington, Ky., Southern Appalachian Good Roads Association. Dr. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

Sept. 19-20, at Santa Barbara, Cal., Pacific Coast Gas Association. Henry Bostwick, secretary, San Francisco, Cal.

Sept. 18-20, at Philadelphia, Pa., Illuminating Engineers' Society. Jos. Langan, secretary, 29 West 39th street, New York City.

Oct. 2-6, at Grand Rapids, Mich., Playground and Recreation Association of America. H. S. Vaucher, secretary, 1 Madison avenue, New York.

Oct. 9-13, at Robert Treat Hotel, Newark, N. J., American Society of Municipal Improvements. Chas. C. Brown, secretary, 702 Wulsin building, Indianapolis, Ind.

Dec. 5, at Chicago, Ill., United States Metal Culvert Association. A. W. Dowlers, secretary, 1102 Tacoma building, Chicago, Ill.

Dec. 6-8, at Washington, D. C., National Rivers and Harbors Congress. S. A. Thompson, secretary, 824 Colorado building, Washington, D. C.

Feb. 5, 1917, at Boston, Mass., American Road Builders' Association and Road Congress. E. L. Powers, secretary, 150 Nassau street, New York.

An Acknowledgement

In connection with the article on the "Municipal Asphalt Plant of Manhattan Boro," in the May number of MUNICIPAL ENGINEERING, credit for the data was inadvertently omitted. The material in the article appeared, much of it, in a paper on the plant before the Municipal Engineers of the city of New York, by William Goldsmith, construction engineer.

Chicago Preparedness Parade

Following the great preparedness parade in New York, which marched for thirteen hours to pass a given spot, is the Chicago parade of June 3, which promises, as this is written, to be equally great, and has doubtless demonstrated it by the time this is read. Eighteen engineers' organizations are represented in the committee and the indications are that several thousand individual engineers will appear in the engineers' section, headed by the Naval Consulting Board.

The weekly meetings and drills of engineers are well attended and the lectures are of absorbing interest. At the meeting of May 25, Ernest McCullough, who has had twenty years of experience in the National Guard, advancing to the rank of major, gave an illustrated lecture on modern field pieces and the work of batteries in the field, with an explanation of the mathematical problems involved in accurate marksmanship with cannon of various designs. At the meeting June 1, Philip Sampson, of Chicago, invalided back to Canada as the place of his enlistment, gives a story of his experiences in the Canadian contingent in training and in war. Captain H. B. Sauerman reads a paper on field fortifications, and Captain L. S. Marsh gives instruction on patrolling. These are samples of the weekly work of the Chicago Committee on Military Engineering.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

June 7, 8: Mining draftsman in Bureau of Mines, Pittsburg, Pa., at $1,200 a year.

June 7, 8: Aid in Coast and Geodetic Survey, beginning at $900 a year.

June 13: Expert radio aids in machinery division, Mare Island Navy Yard, California, and department of steam engineering, Navy Yard, Washington, D. C., at $6 a day.

June 13: Mineral technologist, in Bureau of Mines, Washington, D. C., and in field at $2,400 to $3,600 a year.

June 20: Metal mining engineer in Bureau of Mines, in the field, at $2,400 to $4,000 a year.

June 21: Assistant physicist, qualified in spectroscopy, in Bureau of Standards, Washington, D. C., at $1,400 to $1,800 a year.

June 21: Master mechanic in forge shop, naval gun factory, Navy Yard, Washington, D. C., at $7.44 a day.

June 21: Junior electrical engineer, Bureau of Mines, at Pittsburg, Pa., at $960 to $1,200 a year.

July 5: Assistant sanitary engineer in Public Health Service, at $1,600 a year.

Technical Schools

The extension division of the Portland Cement Association will hold a short course in concrete for manual training and vocational teachers, at Lewis Institute, Chicago, June 26 to July 1.

The latest bulletin of the Engineering Experiment Station of the University of Illinois are No. 84, on "Tests of Reinforced Concrete Flat Slab Structure," by Prof. A. N. Talbot and W. A. Slater, and No. 85, on "The Strength and Stiffness of Steel Under Biaxial Loading," by Albert J. Becker. W. F. M. Goss, Director, Urbana, Ill.

A recent bulletin of the University of Michigan makes general announcement of the courses of study of the colleges of engineering and architecture for 1916-17 in about 200 pages of text.

The Municipal University of Akorn, O., issues the announcement for 1916-17 of its college of engineering, which is operated on the Cincinnati University co-operative plan. The work next year covers three of the five years of the full course.

Personal Notes

Paul Riston has been elected city engineer of Punxsutawney, Pa.

Joseph W. Hunter, long connected with the Pennsylvania State Highway Department, is acting commissioner on account of the death of Commissioner Robert J. Cunningham.

Herbert C. Keith, consulting engineer in bridge and structural work, masonry, foundations, railroads and legal engineering, has moved his offices to the Tribune building, 154 Nassau street, New York.

Caleb Berry is the city engineer of Centralia, Wash.

I. B. Funk is the new city engineer of Newport Beach, Cal.

Charles E. Hewes has been given the duties of city manager of Alhambra, Cal., in addition to those of city engineer, which he has been performing.

Henry Rohwer, graduate of German universities and well known engineer on railroad location and construction and as chief engineer of the Gould system, died in St. Louis, May 4. Some of his earlier work was municipal, as city engineer of Omaha in 1877 to 1881. He was one of the earliest advocates of good roads in Missouri and was prominent in the first good roads meeting in that state in 1893.

Geo. H. Randall is city engineer of Oshkosh, Wis.

Andrew F. Macallum, who has been city engineer at Hamilton, Ont., for about seven years, goes, this month, to Ottawa as commissioner of works. Mr. Macallum's experience at Hamilton has been quite large and varied, as he has spent over a million dollars rebuilding the water works system, has built trunk sewer systems for the east and west ends of the city, and a sewage disposal plant for the west end, also about 22 miles of permanent pavements by day labor, including a new municipal asphalt plant. Before his employment at Hamilton, he was connected with water, sewer and other municipal work in several Canadian cities, for a number of which he is and has been consulting engineer. His experience also includes railroad work all the way along the line, including chief engineer. Mr. Macallum is a member of both the American and Canadian Societies of Civil Engineers and is the president of the American Society of Municipal Improvements, of which he will be the presiding officer at the Newark convention next fall. He is a graduate of the University of Toronto. Mr. Macallum takes to his new work a ripe experience and his competency has been especially recognized by his professional brethren, as indicated by the honors they have conferred upon him.

William Powrie, city engineer of Waukesha, Wis., is now also president of the board of public works.

James Allen, formerly chief engineer of the Washington State Highway Department, has been appointed State Highway Commissioner.

Stanley H. Rose, until recently in charge of the New York office of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, has been engaged by the Barber Asphalt Paving Co. to direct its foreign trade department. Prior to his appointment as commercial agent of the bureau, Mr. Rose had had an extensive business experience in the larger part of Europe, Australia, New Zealand, India and Egypt, and had also held important posts with American and European firms engaged in foreign trade. He is considered an expert in foreign tariffs, trade regulations and shipping. As special agent of the Bureau of Foreign and Domestic Commerce, Mr. Rose has just completed a tour of more than fifty cities of the Middle West, South and Southwest, acquainting manufacturers with foreign trade opportunities and advising commercial organizations as to the best methods of promoting export trade. Mr. Rose was educated in London, Berlin, Paris and Brussels, and speaks most of the modern languages. The Barber Company's export trade in paving materials, roofing and other asphaltic products will hereafter be in Mr. Rose's charge, with headquarters in Philadelphia and New York.

Lester Kirshbraun, consulting engineer, Chicago, Ill., will supervise the construction of pavements in Beloit, Wis., during the season of 1916.

L. A. Nicholson is the new city engineer of Tacoma, Wash.

Earl A. Zeisloft is city engineer of Akron, O.

T. L. Higgs has been appointed city engineer at Parkersburg, W. Va.

Joseph M. Tracey is city engineer of Ogden, Utah.

Charles W. Gossart is boro engineer of Kutztown, Pa.

G. N. Adams is the new city engineer of Tropico, Cal.

Albert Wostenholme has been promoted to city engineer of Fall River, Mass.

Edward R. Stapley is resident engineer for Wilson, N. C., which has nearly $500,000 of improvements under construction.

Charles Cottingham, consulting engineer, Danville, Ill., has moved his office to the Daniel building.

MACHINERY AND SUPPLIES

Ten Years of the Motor Tractor

Fifteen years ago at the opening of the present century, the steam tractor had reached its fullest development and steam tractors had become a common sight in all sections of the country doing the many kinds of work to which a tractor could be adopted. During the last ten years of the nineteenth century it had taken its place as one of the country's indispensable machines and yet today it has almost disappeared.

When the gasoline or kerosene motor had been fully developed and applied to a tractor its superiority over the steam tractor was so obvious and was so quickly recognized that the use of the steam tractor simply faded away.

In a recent issue of the *Farm Implement News*, devoted to the tractor industry, there is given a tractor directory in which are listed alphabetically by name one hundred and forty-six tractors. Everyone of them is a gas or motor tractor and there is not a steam tractor in the whole list.

There is only one modification to the above sweeping statement and that is as it applies indirectly to the steam roller. A roller is mainly a tractor with heavy wheels. Much of the work required of it is exactly similar to that of any other kind of tractor and the reasons for abandoning the steam tractor in favor of the gas tractor apply with equal force to abolishing the steam roller in favor of the motor roller so far as such use is concerned.

Ten years ago there was not a motor roller in America. The first one built in this country was the Austin motor roller of the Austin-Western Road Machinery Co. Since then its sales, both actual and relative, have increased annually by leaps and bounds until today a very large percentage of all power rollers made in this country are motor rollers and probably ninety per cent of the motor rollers are Austin rollers.

Portable Steel Clam-Shell Tractor

We are illustrating a Byers No. 331 baby excavator as used for unloading gondola cars. This outfit has also been used for digging sewers, back-filling trenches, etc.

The frame is constructed of heavy section deep steel channels, cross-braced and trussed.

The car body is 15 feet long by 6½ feet wide; width of outside wheels (forward and rear wheels track) 9½ feet; wheel base 13 feet; height from ground to top of A frame 12 feet; boom easily lowered and stack removed for close clearance; width of outside outriggers, folding, 18 feet; size of bucket to use, ½-yd. clam shell or 1/3-yd. orange peel; length of boom, 20 feet for heavy bucket, 26 feet for light bucket; weight complete without bucket, 19,000 lbs.

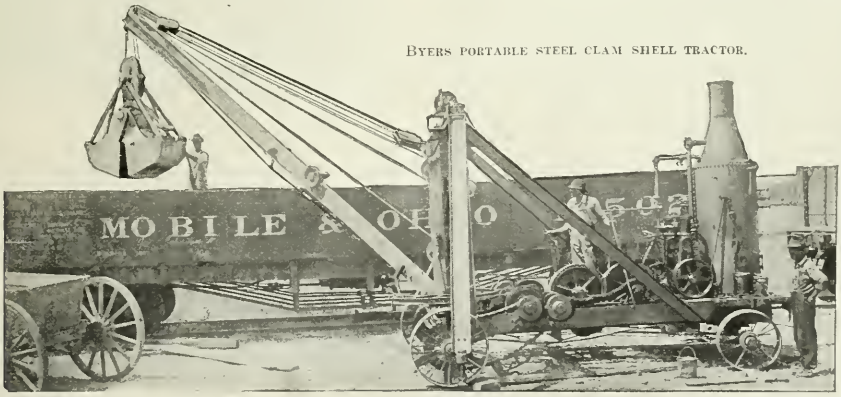
For sand, gravel, screenings small coal and similar loose material, almost any light standard bucket does well. But in 1-in. or 3-in. crushed rock, slag and such dense interlocking materials, it is very important to have a high-powered bucket and sometimes even the addition of teeth. Consequently it is very important to have a bucket adapted to the service, as otherwise results may be very disappointing.

This outfit is manufactured by the John F. Byers Machine Co,. Ravenna, O.

Tarrant Oil Distributer.

The Tarrant Manufacturing Co., Saratoga Springs, N. Y., are marketing two pressure oil distributers.

The smaller one is of 100 gallons capacity. This outfit is equipped with a gasoline engine and air compressor mounted on a separate truck, which, during the interval of filling the machine with oil, pumps up an air pressure of 100 lbs. on the small tank, which is afterwards used in distribut-



BYERS PORTABLE STEEL CLAM SHELL TRACTOR.

TARRANT OIL DISTRIBUTER APPLYING SQUEEGEE COAT OF ONE-HALF GALLON PER SQUARE YARD.

ing the oil from the larger tank. This machine is mounted on two wheels, weighs approximately 1,600 lbs. when filled with oil, spreads 8 ft. wide, and, while we recommend a mechanical haul for the purpose of getting an even distribution, it can be horse-drawn.

On both of the Tarrant machines the distributer swings horizontally when in use. The advantage of this feature is to keep the distribution even on the road surface even tho the roller man can not drive his roller in a straight line. It fills the skips and bare places left in the road, which is only possible with these machines.

The larger machine, illustrated, is of 200-gallon capacity, weighs approximately 2,500 lbs. when full, spreads 8 ft. wide, is equipped with a two-cylinder steam driven air compressor which is driven by steam from the roller and furnishes the air for distributing the oil. The photograph shows this machine spreading an 8 ft. strip of one-half gallon to the yard, and, as these photographs are untouched they show very plainly what the machine can do.

Novaculite for Street and Road Construction

Novaculite is an uncrystalized quartzite, being 98 per cent silica, and entirely free from lime or other alkaline substances. It is very much like flint, and occurs in large quantities in Southern Illinois and Missouri, and at many places in Arkansas; some forms of it are used for razor hones. As usually found in these localities, it forms the undecayed portions of a porphyritic formation belonging to the unstratified or primitive rocks, in conjunction with the granites. The softer ingredients of this formation have degenerated or decayed, leaving the silicious portions in a very much broken up condition, more or less uniformly dispersed in a cement like matrix, or bonding material, which is the decayed remains of the less permanent ingredients of the primitive rock, and is spoken of as "the bond."

This quartz, or Novaculite rock, is the hardest of rocks; it scratches glass like a diamond. It resists all disintegrating action of the weather when exposed for long ages, as is evidenced by the sharp outlines of the exposed tops of the quarry hills. Hundreds of thousands of years of exposure to the elements have not rounded or worn away the sharp angles and corners still exposed to these disintegrating influences. A Novaculite fragment with corners rounded by exposure does not exist.

While this material is quite common in Missouri and Arkansas, it seldom is mixed with just the proper proportions of bonding material to adapt it for paving purposes. In Illinois quarries, however, it forms 90 per cent. of the whole, leaving just enough of the bond to cement it into an absolutely solid and impervious mass, very much like cement concrete. It differs from concrete, however, inasmuch as when the bond is broken it will form again on a thoro rolling or ramming; whereas cement concrete is brittle, and when once cracked or broken it cannot be again united.

The Novaculite portion is found very much broken up into sharp angular masses, from the smallest visible particle to lumps of several cubic feet in size. All these large lumps, however, are very much cracked and easily broken into fragments by a few blows of a sledge or hamer.

The city of Cairo, Ill., first used Novaculite in the construction of streets some 25 years ago, and a number of the original streets are still in use; very little spent on them in maintenance, and in fairly good condition considering the length of service. This city constructed two new districts this season, which would seem to indicate that Novaculite has proven satisfactory to them. Geo. F. Dewey is the city engineer.

Novaculite was used to a large extent in the construction of the highways of Madison County, Tenn., these roads having been in service 13 years. Large quantities have been used for road construction in Lee, Monroe, Chickasaw, Clay, Lowndes, Lauderdale and Warren counties, Mississippi. The highways in Lauderdale and Warren counties have been pronounced the best in the south. Novaculite has also been used for street construction in Fulton, Ky., Union City, Trenton, Jackson, Ripley and Dyersburg, Tenn., and Tupelo and Meridian, Miss.

Novaculite was used in the construction of the mile of road constructed under the State-Aid at Hodges Park, Ills., last year. The material was straight run of the quarry for the base, and Nos. 2 and 3 sizes mixed used for the top, with a small amount of No. 3, the small size, used for touching up any places that appeared coarse. The roadway proper is in good condition, altho better results might have been secured had No. 1 or coarse size been used for the base instead of the pit run. The earth shoulders on this road show some wash from rains, the soil being of a sandy nature, and now require some attention. About three more miles of road adjoining this one will be let in June. B. H. Piepmeier is the maintenance engineer for the State Highway Department.

Kreolite End-Lug Grooved Blocks

By W. E. Wright.

The design of Kreolite end-lug grooved blocks, for flooring, is intended to retard the effects of expansion and contraction under varying conditions.

Government experts have shown that the shrinkage of untreated southern yellow pine, from the green to the kiln-dried state, may amount to 10 per cent. of its volume—about 2½ per cent. along the radius and about 7½ per cent. along the tangent to the yellow growth rings.

An examination of the growth rings of ordinary rectangular creosoted wood paving blocks will disclose the fact that nearly nine-tenths of all blocks are manufactured so that the maximum tangential shrinkage or expansion will occur. Very few rectangular blocks have the heart "boxed in", so that but few blocks exert the lower radial variations as to volume.

The function of the groove of the Kreolite end-lug grooved block is to destroy the peripheral tension of the annual growth

FIG. 1.

FIG. 2.

FIG. 3.

rings, by exposing the inner rings to the air so that they may dry and shrink with the same degree of rapidity as the exterior growth rings. Three grooves or notches, extending into the wood about ¼ inch, are placed on one side of each block, so that one groove will under all conditions break the continuity of the annual growth rings, the entire depth of the block, at, or near, the point of tangency to the side of the block. The grooves in the side of the block convert the greater tangential variation in volume to the lesser form of radial shrinkage or expansion. The groove, therefore, retards to a very great degree the tendency of the block to shrink.

Figures 1, 2 and 3 show blocks cut from different portions of the cross section of a tree, demonstrating that one of the grooves will break the annual growth rings at, or very near to, the point of tangency with the side of the block.

The wedge-shaped or pointed lug of the Kreolite end grooved block is an integral part of the wood, placed in the center of one end and extending the full depth of each block, and protruding therefrom ¼ inch. As the wood swells or expands, the lugs compress, providing a uniform, individual expansion joint for each block, preventing damage due to expansion.

The grooves are also wide enough to permit a bituminous filler to penetrate the full depth of the blocks, even when laid up closely, thus binding them more efficiently into a solid, wearing surface.

Segment Culvert Blocks

Vitrified segmental blocks, which have been quite extensively used the last two or three years in sewer construction, are being introduced for highway culverts, particularly in the clay country of the Middle West. The accompanying illustration shows an 84-in. culvert in Kansas which was built by two inexperienced men and a helper in one working day's time. The arch centers used for this work were merely three templets cut to a 24-in. radius and wedged up on 4x4-in. sticks placed across the culvert just below the springing line. The templets were covered with 1x4-in. strips. On completion of a section of the arch the wedges and centering were removed and backfilling proceeded at once, without waiting for the mortar to set. Adjacent blocks are dovetailed to prevent their being

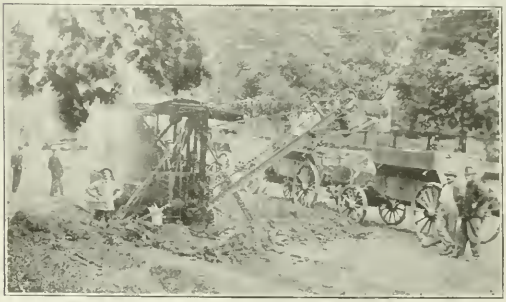
LARGE HIGHWAY CULVERT OF SEGMENTAL BLOCKS.

displaced. These blocks are manufactured by the W. S. Dickey Clay Manufacturing Co., Kansas City, Mo.

Segment block for culvert purposes solve the problem of large culverts at low cost. The culverts, for instance in Johnson Co., Kan., cost slightly over $100 and will replace a $200 bridge. A culvert of this kind can be constructed rapidly and simply, backfilling commenced immediately upon the completion of the arch and the road used at once. They will hold up a great deal of weight and with ordinary care and backfilling cannot be broken down. Head walls are necessary on all culverts to hold the road grade in place and they are advocated on segment block culverts, altho they have been laid without head walls very satisfactorily.

Keystone Traction Excavator

The Keystone Driller Co., Beaver Falls, Pa., are marketing a traction excavator which can be used as a light, portable general utility steam shovel, in conjunction with a dipper scoop. It will take down and load into dump cars or wagons a bank 12 feet high (or higher if the material will cave or can be shot down when undercut). The regular size of dipper scoop used holds ½ cu. yd. The boom being 16 feet long, the material can be taken up from any point and loaded upon dump wagons at any point within a half circle 32 feet in diameter. Material of the hardness of water slates, soft rock, and boulders as much as 24 inches thru can be handled. The speed of operation depends somewhat on the skill of the operator but an average speed would be 20 to 30 dump wagons per hour.



KEYSTONE EXCAVATOR GRADING ROAD WITH SKIMMER SCOOP AT ROCHESTER, N. Y.

This novel outfit may also be used as a dirt loader and grader. When so used it will take up from a few inches to 5 or 6 feet of material and leave a smooth surface at any desired grade or slope. It will load sand, gravel or clay, and boulders up to 20 inches or more in diameter.

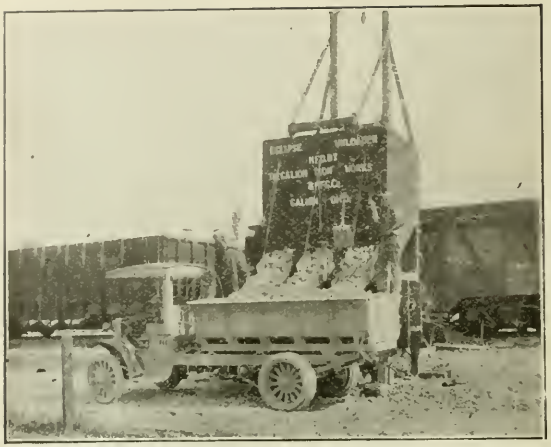
The skimmer scoop, which is the one best adapted for this work, holds about ½ yard. It will readily cut and take up any material which would otherwise be broken by a plow (not rooter). Used in the center of a street not over 30 feet wide, it will grade and load from curb to curb, loading to either side of the machine at will. It will load 15 to 30 dump wagons per hour, owing somewhat to the nature and depth of material to be excavated. The skimmer scoop is 31 inches wide.

When used as ditch digger, the machine is backed away from, and in line with the center of the ditch being made, 7 or 8 feet at a time. In fair material it will excavate to a depth of 10 or 11 feet, depositing the material to either side of the ditch, either on the ground or in dump cars. It can also be used for cellar digging or making narrow cuts within the above depth limit.

Galion Eclipse Portable Loader

The chief units of this outfit consist of the frame, the hoisting apparatus, the bin, the chute and pit, and the power plant.

The Eclipse is first located at a siding and the cars are so moved that the hoppers or slides are over a chute placed under the track thru which the load is discharged into a bucket in a pit which is between the elevator and the track. The bucket is loaded and then hoisted on an inclined track and emptied at the top of the track into a hopper bin, from which it is discharged by gravity thru chutes into wagons, trucks or hauling cars that are driven beside the elevator, three chutes so distributing the loads that trimming is unnecessary. The drivers operate the chutes and load their wagons without delay or assistance.



Galion Eclipse Portable Loader.

The removal of the unloader from one location to another is extremely simple. The track is hoisted from the pit and folded; the tower is demounted and lowered; the side sections of the bin are lowered; the supporting posts are raised on their hinges; trucks are placed under supporting frame, and the unloader can then be easily hauled by a team, truck or road roller.

The safety device which eliminates all possible chance of injury to railway employes and all who have occasion to walk over the chute, operates automatically, as follows:

When ready to unload a car of material, the car is so placed that the hopper in the bottom is directly over the chute; the lock holding the safety cover of the steel chute is released, the gate in the bottom of the car is opened and the weight of the material forces the cover down inside of the steel undertrack chute so that the cover lies flat on the inclined bottom of the chute, in which position it remains until the car and the under-track are empty of material.

As soon as the car is empty and all of the material in it has been emptied into the bucket to be hoisted into the hin, a powerful spring raises the safety cover to its normal position, flush with the top of the two railroad ties, between which the under-track chute is located. The safety cover is automatically locked in this closed position and cannot be opened until the lock is released.

146 Road Rollers Ordered by One Customer

One of the most remarkable events in the road-roller manufacturing business has just occurred in the purchase of 146 road rollers by the Russian government from the Austin Manufacturing Company, Chicago. This order is, without doubt, the largest ever placed in the history of road rollers, either in this country or any other country.

The heading for this article is perhaps modest in that it only refers to the orders placed in April, 1916. As a matter of fact, the Russian government have owned and operated about fifty Austin rollers for a number of years. It can be attributed to the latter fact that this recent magnificent order has been placed with the same concern. The machines are ordered in three different sizes, 8-ton, 10-ton and 12-ton; they are equipped to operate on Russian kerosene oil, the product of the vast oil fields located in southern Russia.

The history of the Austin motor roller has been spectacular. Nine years ago they put their first machine on the market and probably no piece of machinery connected with engineering construction work has ever created so much excitement amongst competing manufacturers, or attracted so much attention from the road building public using road rollers.

The Austin roller was the first motor-driven machine placed on the market in the United States, and it was only natural for it to create tremendous opposition from the old established steam roller manufacturers, who had believed themselves securely entrenched in a market of their own. The opposition to the machine, however, was confined to those interests. It is to the credit of the American road building public that the Austin motor roller got a splendid reception from the very start. The exceptional advantages and improvements it offered were quickly appreciated, and the machines were adopted very rapidly by all sections of the country. In fact, for the first few years after its introduction, the purchases were limited only by the capacity of the Austin shops to build the machines. These shops have been added to four times in the nine years until they are now undoubtedly the largest and most perfectly equipped in the world devoted to road rollers and road making machinery.

If there ever was a foundation to the doubts expressed about the practicability of the Austin motor roller when it first appeared on the market, that foundation has been proved false and been swept away by the enormous success which the roller has met with in every part of the world, and this impressive order for such a large number of machines, is one that all American manufacturers must be proud of.

Waterproofing on the Farm

A booklet of extraordinary interest in connection with concrete construction on the farm is now available for gratuitous distribution by the Sandusky Cement Co., of Cleveland, O. It is entitled "Waterproofing on the Farm," and shows the advisability of many farm structures and the high qualities of Medusa waterproofing for such uses. The horse barn, milk house, ice house, dairy barn floor, silo, corn crib, feeding floor, hog house, water trough, hog bath, hog trough, root cellar, duck pond, etc., and the methods of using Medusa waterproofing are illustrated and described.

Dynamite Does Difficult Ditching

The Southern Drainage & Construction Company, of Kinston, N. C., are engineers and contractors engaged in the development of swamp and overflowed land.

In a drainage proposition near Wilmington, N. C., recently, they required a ditch approximately 12 feet wide at the top, 5 feet deep, and 1,200 feet long. The soil was a heavy, wet muck, covered with a tangle of underbrush and stumps.

President Hodges, of the company, reads the engineering

Harbert Street, Memphis, Tenn.
Constructed with "Tarvia-X", 1911
Treated with "Tarvia-B", 1914

Over 50 Miles of Tarvia in Memphis—

LIKE many other towns Memphis uses Tarvia right along year after year as a fixed policy because tarviated macadam is the most economical roadway for modern traffic.

Memphis began in 1910 with modest experimental stretches of Tarvia work. These proved so satisfactory that larger contracts were made in succeeding years.

The Memphis conditions illustrates the versatility of Tarvia, for Memphis has used Tarvia on many kinds of roadways—gravel, macadam and concrete.

There are three grades of Tarvia and a dozen ways of using them. The processes for treating old roads are somewhat different from building new ones. Climate and traffic have a bearing on the question.

We don't attempt to make one material and one process serve for all kinds and varieties of road conditions. There is a Tarvia process for most road problems.

Write our Service Department for illustrated booklet and further information.

Special Service Department

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by anyone interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Salt Lake City Nashville Seattle Peoria

The Paterson Manufacturing Co., Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

papers and keeps posted on new machinery, new methods and new ideas generally applicable to his contracting business. He had read that ditches could be blasted with dynamite under the conditions that confronted him.

As he had no men in his employ that had had experience in ditching with dynamite, he told his troubles to a professional blaster. The result was a ditch almost as uniform as one dug in the usual way and with much less expenditure of time and trouble.

Professional blasters should seek the acquaintance of every contractor in their localities. Many a good blasting job can be had from contractors if they are kept posted as to what work blasters can be of help to them.

A Double Contractor's Pump

One of the convenient combinations of the Atlantic gasoline pumping engine, made by Harold L. Bond Co., 383-391 Atlantic avenue, Boston, Mass., is one which mounts on one end of the truck carrying the engine a diaphragm pump and on the other end a centrifugal pump.

The engine is of 3½ h.p., with speed of 350 to 550 revolutions a minute, 5-inch bore, 6-inch stroke, with two spark plugs, one connected to Sumter magneto and one to a set of dry batteries.

The pumping engine is connected by back gear to a No. 4 diaphragm pump of 2,500 to 8,000 gallons an hour, depending on speed, height and directness of suction lift.

The centrifugal pump has 3-inch suction, 2½-inch discharge and capacity of 12,000 gallons an hour. It is driven by belt from the engine over a spring tension idler coupled up for 30-foot duty at maximimum speed.

The centrifugal pump may be used in the morning to get rid of excess water quickly atnd operation continued with the diaphragm pump. However, the engine is powerful enough to operate both pumps at the same time at a combined rate of 300 gallons a minute on most jobs.

The Motor Lawn Mower a Decided Advance

The chairman of the green committee of the Sudbrook Park Golf Club, Sudbrook Park, Md., says that they have used an auto mower for two seasons and it has done remarkably good work. It is decidedly faster than a horse motor, cheaper to operate, and has made a decided improvement in their golf course, having rolled it down to a good even turf without any of the cuts which a horse machine makes. They consider the machine indispensable. It was made by the Coldwell Lawn Mower Co., Newburg, N. Y.

Trade Notes

There is some prospect for the sale of concrete mixers in Barcelona, Spain, tho but three contractors in that city use them. The mixer should be sold separately for use with local power apparatus, mostly electric, according to Consul General Hurst.

A new by-product of cement plants is potash salts. When the Riverside Portland Cement Co. were obliged to abate their dust nuisance in the orange region of California some three years since, they found that a commercial amount of low-grade potash salts could be separated from the dust. Their experience is the basis for the installation of similar outfits by the Security Cement and Lime Co., Hagerstown, Md., and the new Universal Portland Cement plant at Duluth, Minn., now under construction.

The price list recently promulgated by all the photo-engravers of the country has been abandoned by the Photo-Engravers' Board of Trade of New York City, as a result of correspondence with District Attorney Swann, of New York county, concerning the proposal of the district attorney to determine by proper court proceedings whether the "standard scale of prices" of the association was not a violation of the Donnelly anti-trust law of the state of New York.

The Barrett Mfg. Co. now offers surety company's guaranty of roofs laid according to The Barrett Specification for twenty years under reasonable requirements as to inspection of contractors' work by the company's inspectors and acceptability of contractor.

The labor situation is the subject of an investigation made by O. R. Rietschlin, the head of the employment department of the Aberthaw Construction Co., Boston, Mass. The report goes into considerable detail and the result, in brief, shows that as compared with normal times New England has a shortage of 47,000 and New York of 110,000 South Italian laborers and that the increase in immigration from other countries is very insignificant. Consequently, the price for unskilled labor in the East must increase materially and will undoubtedly equal or exceed 30 cents an hour.

The output of creosoted wood paving blocks in 1915 was enough for 2,937,132 square yards of pavement, an increase of 12.3 per cent over that of 1914.

The MacArthur Concrete Pile and Foundation Co. have moved their New York office to the Equitable building, 120 Broadway.

The Standard Brick Company, of Crawfordsville, Ind., has taken out a license from the Dunn Wire-Cut Lug Brick Company for the manufacture of wire-cut lug paving brick. This makes thirty companies operating forty-eight plants now engaged in the manufacture of wire-cut lug brick. The Standard Brick Company is an established concern with a daily capacity of 25,000 brick, but it is enlarging its plant to a capacity of 35,000 brick daily with the necessary additional kilns to handle the output. The plant now has seven kilns of 70,000 capacity each.

The Southern Clay Manufacturing Co., Chattanooga, Tenn., has purchased the Graves paving brick plant at North Birmingham, Ala., and will at once begin making wire-cut lug brick at that plant. The Southern Clay Manufacturing Company already has plants at Robbins, Tenn., and Coaldale, Ala. The demand for this type of brick in the South has necessitated the purchase of the additional plant.

Trade Publications

The Electro-Sanitation Co., Los Angeles, Cal., publishes two pamphlets giving engineers' report on sewage disposal plants at Durant, Okla., and New Brighton, Pa.

The Highway Magazine, issued by the American Rolling Mill Co., Middletown, O., shows the value of Armco corrugated culverts and their use in many situations, including culverts under very high fills.

Bulletin 68 of the Blaw Steel Construction Co., Pittsburg, Pa., describes the design and construction of the highest reinforced concrete water tower tank, which is located at Middleboro, Mass.

The Blaw Steel Construction Co., Pittsburg, Pa., have a handsome booklet, entitled "More Profits in Concrete Culvert Construction," which shows the Blaw adjustable rectangular culvert form and gives specifications for it and prices. It is Blaw service bulletin No. 70.

Sternberg 5 and 7-ton motor trucks are shown in their details and in operation for many uses in a large folder, entitled "A Big Message on Big Trucks," of the Sternberg Motor Truck Co., West Allis, Milwaukee, Wis.

The Russel Grader Mfg. Co., Minneapolis, Minn., issue a 100-page catalog of their elevating grader, ditcher and wagon loaders, grader disc plows, road planer, scarifier, road machines, dump wagons, steel beam bridges, corrugated and built-up culverts, scrapers, etc.

A GROWTH BASED ON SHEER MERIT

NO GUESS WORK **NOTHING BUT QUALITY**

Bitulithic pavement has grown from 16,400 square yards in 1901 to the extent of over 39,000,000 square yards in over 400 cities, which is equivalent to over 2,200 miles of roadway 30 feet wide between curbs.

If **Bitulithic** is once adopted for your streets, you will always insist on it. Additional large contracts are constantly being awarded by the cities that have used it for many years.

BITULITHIC means quality

Bitulithic Pavement—intersection Orange Grove Ave. and Colorado St., Pasadena, Calif.

If your streets are paved with **Bitulithic** the attractiveness of your city to visitors as a place of residence will be increased and indirectly result in a growth of population.

Automobilists constantly travelling over the **Bitulithic** streets carry its praise everywhere.

Is not the experience of over 400 cities enough to satisfy you that **Bitulithic** is the **"Best by every Test"?**

"We could build *cheaper,* but we won't—
We would build *better,* but we can't."

Do not wait until a mistake is made—pave your streets with **Bitulithic** and avoid mistakes.

Bitulithic appeals alike to city officials, property owners and automobile drivers.

Bitulithic is a sanitary, dustless, non-skidding pavement, and affords a secure foothold for horses.

Write today for illustrated booklets and learn more about this modern, ideal street pavement for modern cities.

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Lead lined iron pipe is made by the Lead Lined Iron Pipe Co., Wakefield, Mass., who issue a booklet giving many instances of the uses to which it is put by prominent purchasers. They make tin-lined iron pipe also.

The National Concrete Sign and Post Co., Oil City, Pa., send a number of reproductions of photographs of their sign posts, signs and various methods of mounting them on concrete, iron and wood, the process of inbedding the letters in the concrete, building tablets, etc.

The Blackstone process for manufacture of bituminous concrete mixtures for roads and pavements at a central plant is exploited in a pamphlet by J. A. W. Pine, consulting engineer, 15 Broad street, New York.

The Republic Creosoting Co., Indianapolis, Ind., has made a handsome reprint of P. C. Reilly's paper on "The Proper Oil for Treating Creosoted Wood Paving Block," before the American Society of Municipal Improvements, which will be sent to any one interested.

The National Tube Co., Pittsburg, Pa., have a folder descriptive of the motion pictures of the process of making National pipe from ore to finished product.

A booklet of the Semet-Solvay Co., Syracuse, N. Y., is devoted to Solvay granulated calcium chloride, "a national dust layer."

A new book about Medusa waterproofing, issued by the Sandusky Portland Cement Co., Cleveland, O., shows the many uses to which the Medusa waterproofing paste and powder are put in concrete construction, in reservoirs, tunnel linings, pump pits, shelters, farm buildings, concrete blocks, burial vaults, bathing pools, buildings, etc.

"Shale Bed to Road Bed, the story of the best paving brick made," is the title of a very handsome booklet containing "a story of the making of Metropolitan paving brick," by the Metropolitan Paving Brick Co., Canton, O.

Pioneer Expansion Joint Compounds are described in a circular of The Pioneer Asphalt Co., Lawrenceville, Ill., who are producers of the highest quality of bituminous products.

The use of electricity for setting off blasting charges is fully described in numerous articles on the subject in the DuPont Magazine, Wilmington, Del., which will be sent anyone, free, on request.

The first municipal water and light plant in the world to instal Diesel oil engines is at Menasha, Wis. The engines are shown in detail in a circular of the Busch-Sulzer Bros-Diesel Engine Co., St. Louis, Mo.

Oakoal, the product of a process for making fuel of animal droppings, where fuel was scarce, applied to garbage and other city refuse, is shown, as to its practical working, in a booklet of the Co-Coal-Co., Kansas City, Mo.

The Harrison Safety Boiler Works, Philadelphia, Pa., issue a 68-page book on "finding and stopping waste in modern boiler rooms" by the use of Cochrane meters.

Wm. E. Dee Clay Mfg. Co., Mecca, Ind., and Chicago, are distributing a convenient discount price list of the sewer pipe, fire clay flue linings and wall coping which they manufacture.

The Association of Creosoting Companies of the Pacific Coast, Seattle, Wash., has published, in pamphlet form, a valuable paper by O. P. M. Goss, consulting engineer, on "Creosoting Douglas Fir Bridge Stringers and Ties Without Loss in Strength."

Bulletin No. 46023, recently issued by the General Electric Company, describes briefly that company's arc circuit volt meter, which is a special instrument designed for testing direct current series arc circuits. The approximate dimensions and the connections, together with prices, are included.

The Spaulding system of interchangeable metal forms for reinforced concrete construction, patented in 1916, is described in a booklet issued by the Pyramid Fireproofing Company, 52 Vanderbilt avenue, New York.

The Precision Computer

A new calculator for engineers which gives an accuracy 100 times as great as the slide-rule has been recently devised and placed on the market. Tho but 8 inches in diameter its accuracy is equivalent to that of a slide-sule 100 feet long; it combines the accuracy of 5-place, interpolated logarithms with the speed and convenience of a slide-rule, without the drawbacks of either. It solves expressions like $(879.65+74.769) \times 72.638=854.58$—with an ultimate accuracy of 1/1000 of 1%, or 1 in 100,000.

The length of scale is 120 times as great as that of the A and B scales in the ordinary 10-inch slide-rule; the system of graduations is uniform thruout, and reads 5 figures thruout, like 24364, 67342, 99893, etc.; the variable graduations of the slide-rule have been eliminated in this computor. Most engineering data has an accuracy of from 3 to 5 figures, and calculations have therefore been carried out heretofore by logarithms to 5 places. The Precision Computer has been devised to do this work automatically.

The Ross Precision Computer consists of a graduated dial rotating under a slotter cover, a floating guide, and a slide mounted at the right of the slot. The operation of the dial gives results to an accuracy of 5 significant figures throughout. The slide carries a miniature of the dial scale, and may be used alone to obtain an accuracy of 3 figures; it co-operates with the dial to check and point out the precise answer, and to locate its decimal point.

To multiply and divide any series of numbers it is only necessary to set each number in succession under the reading line in the slot; the answer is then read, also under the slot-line. The manipulations for setting the given numbers on the dial are extremely simple; succint directions are given on the face of the computer.

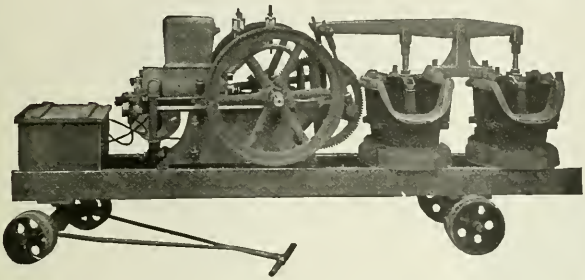
The use of the instrument requires no knowledge of mathematics or logarithms—it reads as simply as a foot-rule or watch-dial; but if desired the computer may be used to read 5-place logarithms and anti-logarthms of all numbers directly, much faster than from logaritbmic tables, and obviating besides, fingering pages of tables, mental interpolations, and errors. Powers, roots and other complex operations may be carried out either approximately, or to a high degree of precision, as desired. Trigonometric calculations made by the Precision Computer give an accuracy of from 3 to 5 seconds of arc.

The Precision Computer is made of metal thruout; the graduations are engraved on silvered metal surfaces, like a surveyor's compass or transit. The instrument is packed securely in a flexible case, and forms a permanent, portable and inexpensive precision computer. It has been invented by Louis Ross, civil engineer, San Francisco; and is manufactured by the Computer Mfg. Co., 25 California street, San Francisco.

The ATLANTIC

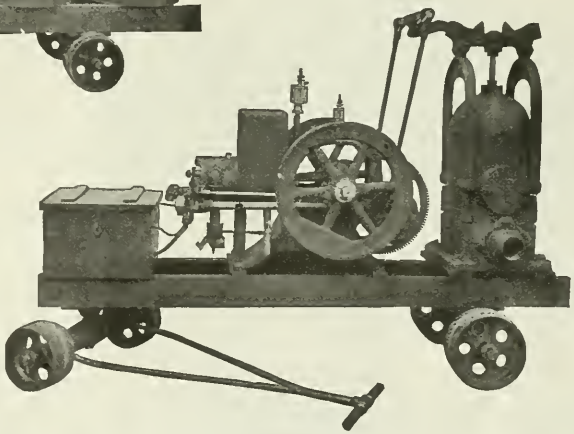
GASOLENE PUMPING ENGINE

is Economical—Reliable—Unequalled—
Easily moved from place to place



This is our
3-inch Double Diaphragm Trench Pump
List Price - - $220.

We also carry a 4-inch Double at List, $250.



Opposite is our
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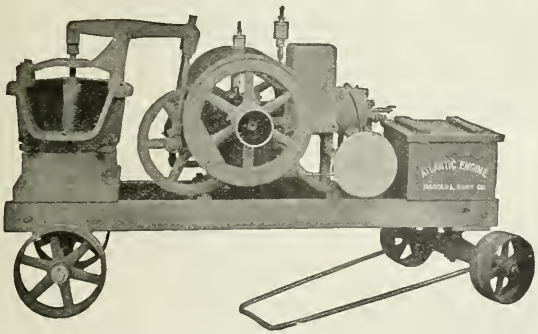
List Price, $180.

It is just the outfit for removal of sewage matter from cesspools and drains. Odorless and sanitary.



New 4-inch Atlantic Diaphragm Trench Pump
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Contracting News

AUTOMOBILES, FIRE APARATUS AND MOTOR EQUIPMENT.

BIDS REQUESTED.

East Rutherford, N. J.—June 2nd until 8 p. m., for one automobile fire engine. c. c. $300. W. W. Patrick, Boro Clerk.

Glen Ridge, N. J.—June 12th until 8 p. m., for motor-driven combination chemical and hose wagon, and alternate proposals on similar piece of apparatus equipped with an auxiliary or booster or junior pump. John A. Brown, Boro Clerk.

Hackensack, N. J.—June 5th until 11 a. m., bids will be received for one 1-ton automobile truck. Address James M. Harkness, Clerk Bd. of Chosen Freeholders of Bergen County.

McComb City, Miss.—Until June 6th for 1,000 ft. Fire hose. L. H. Marsalis, city clerk.

CONTRACTS AWARDED.

East Liverpool, Ohio—Contract awarded Gamewell Fire & Police Telegraph Co., Binghamton, N. Y., for installation of modern fire and police alarm system. Bid $6,700.

Erie, Pa.—Following contracts awarded: Eureka Fire Hose Co., 400-ft. Red Cross Brand; Bi-Lateral Fire Hose Co., 400-ft. Ohio; B. F. Goodrich Co., 400-ft. White King; Boston Woven Hose & Rubber Co., 200-ft. Fire Jacket; C. C. C. Fire Hose Co., 200-ft. Ironsides; The Republic Rubber Co., 200-ft. Relief; Gutta Percha & Rubber Mfg. Co., 200-ft. N. Y. Double Jacket brand.

Hallway, N. J.—The American La France Fire Engine Co., Elmira, N. Y., awarded contract for one motor pumping engine at $8,500.

Washington, Ind.—Purchase of motor combination chemical engine and hose car from Robinson Fire Apparatus Co., St. Louis, voted by City Council.

West Hoboken, N. J.—To American La France Fire Engine Co., Elmira, N. Y., contract for furnishing one 750-gal., triple combination, pumping hose and chemical fire engine at $10,000 and one 75-ft. front drive, tractor drawn aerial truck at $7,800.

CONTEMPLATED PURCHASES.

Anamosa, Iowa—Purchase of one piece of motor fire apparatus is being agitated.

Creston, Iowa—Purchase of motor fire apparatus is being considered by Volunteer Fire Co.

Eagle Pass, Tex.—Purchase of one triple combination pumper being considered. J. B. Plumb, Fire Chief.

Fremont, Nebr.—Purchase of ladder truck being considered. Geo. F. Walz, Mayor.

Glendale, Ohio.—Bond issue authorized to provide for purchase of motor apparatus.

Hammonton, N. J.—Purchase of motor apparatus for two fire companies recommended. Address Fire, Water & Light Comm.

Klamath Falls, Ore.—Proposed purchase of fire apparatus will be voted on shortly. W. H. Mason, Mayor.

Lordsburg, N. Mex.—Citizens are agitating better fire protection.

Marion, Ohio—Purchase of motor driven sweeper and truck at cost of $6,500 provided for in recent bond issue. Mr. Sautter, Mayor.

Monrovia, Cal.—Immediate installation of modern fire equipment is being urged by Fire Chief Geo. C. King.

Santa Ana, Cal.—Purchasing agent has been authorized to secure bids for one-ton truck and for 1½-ton truck for maintenance dept. Address City Purchasing Agent.

St. Charles, Ill.—Motor driven fire truck will be purchased. Edward Hunt, Mayor.

Snyder, Scurry County, Tex.—Committee appointed to investigate purchase of motor driven fire truck and other improved fire equipment. Mr. Howell, Mayor.

Wilmington, N. C.—Purchase of fire apparatus will be voted on June 3rd. Parker Moore, Mayor.

Womelsdorf, Pa.—Town plans motorizing several pieces of apparatus. Mr. Hafer, Fire Chief.

BRIDGES.

BIDS REQUESTED.

Bloomington, Ind.—June 6th until 2 p. m., for construction of nine bridges, seven on Dixie Highway. W. F. Kinser, Aud. Monroe County.

Cleveland, Ohio—Until June 3rd, for bridge and culvert construction on Cleveland-Sandusky Road, Cuyahoga County. Address State Highway Commr.

Hettinger, N. D.—June 5th until 3 p. m., for furnishing steel for seven bridges in Adams Co., Walter F. Kelley, county and.

Jasper, Ind.—June 7th until 2 p. m., for one steel bridge across Patoka River, roadway 18-ft., length 85-ft., concrete abutments and one concrete pillar in center of bridge. Jacob H. Seng, Aud. DuBois Co.

Philadelphia, Pa.—June 13th until noon, for bridge on line of Bensalem Ave. over Pennypack Creek (3 concrete arches, 60-ft. 100-ft., 60-ft spans; 80-ft. wide. Concrete retaining walls. Concrete balustrade, and grading.) Appropriation $200,000. Geo. E. Datesman, Director, Room 416, City Hall.

Salem, N. J.—June 9th until 10:30 a. m., for constructing new draw span, together with supporting pier and fender to protect same, and new fixed span at southeast end of Penns Neck Bridge, over Salem River. c. c. $1,000. H. P. Gray, Director, Bd. Chosen Freeholders of Salem County.

Ventura, Cal.—June 15th until 11 a. m., for reconstructing south approach to Saticoy Bridge, across Santa Clara River. c. c. 10% of bid. J. B. McCloskey, County Clerk.

Westfield, Ill.—June 20th until 11 a. m., for reinforced concrete bridge work in Coles County and Clark County. Address Zane Arbuckle, County Supt. of Highways, Marshall, Ill.

CONTRACTS AWARDED.

Billings, Mont.—To Security Bridge Co., Seattle, Wash., two bridges over Clearwater River and Ford Creek, at about $23,000.

Bridgeport, Conn.—To Edward DeVoe Tomkins, Inc., New York, Contract for East Washington Ave. bridge at $148,725 and for Grand St. bridge at $233,394.

Dayton, Ohio—To The Hackedorn Contracting Co., Indianapolis, Ind., construction of 5th St. bridge, a reinforced concrete structure about 700-ft. long and 56-ft. wide, at $188,000.

Fayetteville, Ark.—To Vincennes Bridge Co., Vincennes, Ind., two steel bridges on concrete foundations, in County at $10,875.

Indianapolis, Ind.—For construction of reinforced concrete arch bridge over Pleasant Run at Vila Ave. The American Constr. Co., Indianapolis, lowest bidder $17,900.00. B. J. T. Jeup, City Engr.

Lowell, Mass.—To The National Engr. Co., 3-span reinforced concrete bridge over Pawtucketville St. at $115,410 and $2,800 extra for excavations.

Orofino, Ida.—The Security Bridge Co., Seattle, Wash., lowest bidder for steel wagon bridge across Clearwater River at Ahsahka, bid $24,870.

Platteville, Wis.—To Wm. Shons, Freeport, Ill., four reinforced concrete bridges in Grant County at $14,411.42.

Springfield, Ill.—To C. N. Lund & Co., St. Louis, Mo., Ten Mile Bridge in Pondulac Twp., Tazewell County, at $3,546.00. To Wm. J. Fowler, La Harpe, Ill., Rice Bridge in Durham Twp., Hancock County, at $1,850.00.

Springfield, Ill.—To Wm. Pohl, Berta Bridge on line between Grundy & Will Counties, at $3,195.50 including piles; to Vincennes Bridge Co., Vincennes, Ind., Fry Bridge in Allison Twp., Lawrence County, at $2,056; to Wm. Lough & Son, Marion, Ill., Pluck Bridge in East Marion Twp., Williamson County, at $1,253.00.

CONTEMPLATED WORK.

Chicago, Ill.,—Ordinance passed providing for bond issue of $5,100,000 to be submitted to voters of Chicago at election on June 5th. Edw. Mohr, Vice Pres. of Franklin-Orleans Bridge Assoc.

Courtland, Kans.—Erection of bridge across Republican River on Line between Republic and Jewell Counties planned. Estimated cost $15,000. Address Commrs. of either County for further information

Dallas, Tex.—Expenditure of $30,000 for constructing east approach to Forest Ave. bridge will be recommended by City Commrs. Otto H. Lang, Street Commr.

Harrisburg, Pa.—Plans being prepared for Walnut St. Bridge. Greiner & Whitman, Consult. Engrs., Baltimore, Md.

Lewiston, Maine—Plans being prepared for bridge over canal at Main St., to cost about $21,000. Sanders Engr. Co., 102 Exchange St., Portland, Maine.

Medicine Lodge, Kans.—Bids will be received soon for constructing 600-ft. pile bridge with concrete floor and 100-ft. steel bridge with concrete floor. W. S. Grant, County Clerk.

Rockwell, Tex.—Plans approved for bridge over East Fork of Trinity River. J. F. Witt, Engr., Dallas, Tex.

Strawn, Tex.—Bridge across Palo Pinto Creek on Breckenridge Road contemplated by Palo Pinto County Commrs. J. T. Ranspot, County Judge.

BUILDINGS.

BIDS REQUESTED.

Bargersville, Ind.—June 10th until 2 p. m., for addition to high school bldg. in Union Twp., Johnson County. Lee Rivers, Twp. Trustee.

Boardman, Ohio—Until June 5th, for erection of school bldg., Youngstown.

Chambersburg, Pa.—June 6th until 9 a. m., for three-story brick addition to County Home. c. c. $400. W. S. Kolb, Clerk, Co. Commrs. M. R. Rhodes, Archt., Chambersburg.

Huntington, Ind—June 8th until 1 p. m., for two-story and basement school bldg. to be erected at Bippus, Ind. Separate bids to be received on heating, ventilating, plumbing and lighting. c. c. $1,000. John H. Sell, Trustee Warren School Twp., Bippus, Ind.

Manistique, Mich.—Until June 8th, for erecting High School Bldg., also bldg. containing gymnasium, shop and heating plant. Separate bids for heating, plumbing, etc. Alice G. Reilly, Secy, Bd. of Educ.

Medora, Ind.—June 15th until noon, for new school bldg. for Carr Twp., Jackson County. Alexander Carr, Twp. Trustee.

New Albany, Ind.—June 28th until 10 A. M., for constructing Floyd County Infirmary. Emile Dupaquier, County Aud.

CONTRACTS AWARDED.

Camden, N. J.—To Cramp & Co., Philadelphia, Pa., erection of Camden High School Bldg. in Forest Hill Park at $360,-451.00.

Carbondale, Pa.—To Herman Mallander Wilkes-Barre, Pa., high school bldg. at $119,239.

Cleveland, Ohio—To Alexander Bros., 323 Williamson Bldg., Cleveland, school bldg. on Fowler Ave. Estimated cost $75,000.

Gaylord, Minn.—To The Olsen & Jonson Co., Great Falls, Mont., courthouse, at $200,000.

Kimberly, Ida.—For construction of high school bldg.—F. Harding Allen lowest bidder, Empire Bldg., Seattle, Wash., bid $33,-833.00.

Loveland, Colo.—To Anton Davidson, Denver, Colo., high school building, at $88,000.

Montpelier, Ida.—Murray & Marshall, Pocatello, Ida., submitted lowest bids for construction of city hall. Bid $21,296.00.

Portsmouth, Pa.—To Nash-Jones Co., Norfolk, at $30,400.00, contract for 16-room school building, in South Norfolk.

Spring Valley, N. Y.—To W. B. Eyris, Grantwood, N. J., school building at $28,-365.00.

Wabasha, Minn.—To John Moline, St. Paul, city jail and sheriff's residence, at $21,188.

Wichita Falls, Tex.—To The Lisle-Dunning Constr. Co., Oklahoma City, erection of Wichita County courthouse at $200,250.00.

Woodlawn, Pa.—To Wallis & Carely Co., Sharon, Pa., 12-room school building at $63,168.

CONTEMPLATED WORK.

Amesbury, Mass.—Bond issue of $125,000 voted for new high school bldg. Address Bd. of Educ.

Preserve Metal Reinforcement

The Dilworth public school building is one of the largest in the district, and 1500 pounds Medusa Waterproofing were used by the contractors and builders who advise as follows:

Pittsburgh, Pa., Sept. 2, 1915.

The Sandusky Cement Co.,
Cleveland, Ohio.

Gentlemen:

We built the Dilworth school and used considerable Medusa Waterproofing in roof fill to keep the moisture from the metal reinforcement. We used the material in accordance with your directions and found the same very satisfactory. This building cost about $230,000. Yours very truly,

Dawson Construction Company,
L. V. Dawson, President.

Medusa Waterproofing

POWDER OR PASTE

Will make all concrete permanently waterproof.

Write for our new illustrated catalog of convincing evidence

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Department X-2, Engineers Bldg.
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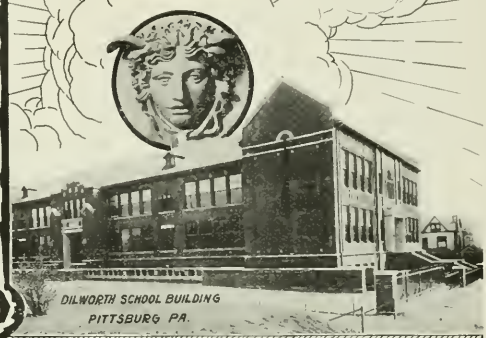

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Note the angle irons employed for the protection of the concrete base. An efficient and lasting drainage structure for situations where head room is limited.

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Armco Iron Culvert Mfrs. Assn.,

CINCINNATI, OHIO.

Contracting News

Anthony, Kans.—Bond issue of $12,000 voted recently for new city hall.

Brooklyn, N. Y.—Appropriation of $5,900,-239, voted by Bd. of Estimate for construction of four new school bldgs., additions to four old bldgs. and for alterations and equipment for various schools. Wm. G. Wilcox, Pres. Bd. of Educ.

Center, Mo.—Bond issue fo $13,400 voted for construction of new school bldg. Wm. H. Hulse, Pres. Bd. of Educ.

Dwight, Ill.—Plans are being drawn for new city hall. W. G. Foster, Archt., Streator, Ill.

Elkhart, Ind.—Erection of new school auditorium at cost of $25,000 being planned. Address Bd. of Educ.

Harper, Kans.—Election will be called to vote on bond issue of $40,000 for new high school bldg. for School Dist. No. 5. Mr. Dryden, Mayor.

Indianapolis, Ind.—New high school bldg. on Winona Technical Grounds will be constructed shortly. Estimated cost $35,000. Contract will probably be awarded late in June. Rubush & Hunter, Archts., Indianapolis.

Newport, Tenn.—Contract will be let in Sept. or Oct. for 2-story brick high school, to cost about $30,000.

New Britain, Conn.—Plans for 24-room school bldg., assembly hall and gymnasium being considered. Address Bd. of Educ.

Osawatomie, Kans.—Bond issue of $42,000 voted for new high school bldg. T. W. Williamson, Archt., Topeka.

Shelbyville, Ind.—Erection of fine station to cost $12,000 being planned. Henry Schlosh, Mayor.

Winchester, Ky.—All bids for County Hospital Bldg. rejected. Estimated cost $50,000. J. W. Crone, Archt., Winchester.

Woodward, Okla.—Preliminary plans being prepared for city hall. Election will be held soon to vote on bond issue of $50,000 for erection of same. C. D. Hill, Archt., Dallas, Tex.

GARBAGE DISPOSAL.

CONTEMPLATED WORK.

Anaconda, Mont.—City desires information on garbage disposal plants. Installation of plant under consideration. W. B. Vestal, City Engr.

Fargo, N. D.—Installation of incinerators being considered. Committee will visit several towns for purpose of selecting suitable model for this city. H. F. Emery, Mayor.

LIGHTING.

BIDS REQUESTED.

Decatur, Ind.—Until June 6th, for installation of new electric unit at city waterworks plant. Address City Council.

Fowler, Ind.—June 3rd until 2 p. m., bids will be received for electric lighting for new school bldg. for Gilboa Twp., Benton County. James Sheedy, Trustee.

Huntington, Ind.—June 8th until 1 p. m., for electric lighting plant for new school bldg. John H. Bell, Trustee, Warren Twp., Huntington County.

Los Angeles, Cal.—June 9th until 4 p. m., for furnishing transmission line insulators. c. c. 10% of bid. Address Jas. P. Vroman, Secy. Dept. of Pub. Service, 506 Knickerbocker Bldg.

Los Angeles, Cal.—June 2nd until 4 p. m., for furnishing electrolytic lighting arresters. c. c. 10% of bid. Jas. D. Vroman, Secy. Dept. of Pub. Service.

CONTEMPLATED WORK.

Albany, N. Y.—Municipal Gas Co., Albany, contemplates extending underground conduit system. Estimated cost $70,000.

Howe, Okla.—Bond issue of $30,000 for waterworks and electric lighting systems voted.

Oakland, Cal.—Plans under way to electrically illuminate Lincoln Highway into Oakland. Plans include lighting of about 4 miles of road. Estimates and plans are now being made by C. E. Hardy, Supt. of Electrical Dept. of city.

Stella, Nebr. — Municipal lighting plant will be voted on May 29th.

Sidney, Ohio—Installation of municipal electric-light plant planned. T. Blake, City Engr.

Tiffin, Ohio—Plans for lighting system being revised and new bids will be advertised for shortly. Walter K. Kepple, Mayor.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Ann Arbor, Mich.—Puntil June 7 for construction of about 11,000 to 14,000 sq yds. vitr. brick pavement. Manley Osgood, City Engr.

Bloomfield, N. J.—June 5th until 8 p. m., for sidewalks, curbs and gutter construction on Glenwood Ave., Cross St., Hill St., and another section on Glenwood Ave. c. c. $200, $100, $100 and $200. Ernest Baechlin, Town Engr.

Cedarville, Ohio—June 7th until noon, for about 4,000 sq. yds. pavement on Main st. Materials—brick, wood block, sheet asphalt, asphaltic concrete, waterbound macadam or tarbound macadam. c. c. 5% of bid. J. W. Johnson. Village Clerk.

Columbus, Ind.—June 7th until 10 a. m., for crushed stone road in Flatrock Twp., a concrete road in Columbus Twp., and crushed stone, Tarvia X or coal tar binder, road in Columbus Twp., with concrete or steel bridge included. W. H. Scott, County Aud.

Columbus, Ohio—June 5th until noon, for grading, draining and macadamizing Scioto and Darby Road in Norwich and Brown Twps. c. c. $2,000. John Scott, Clerk, Bd. of Franklin County Commrs.

Dayton, Ohio—June 6th until noon, for paving Main St. with 3½-in. wood block on 6-in. concrete foundation, setting curb, etc. c. c. 5% of bid. Jas. E. Barlow, Director of Pub. Service.

Dunn, N. C.—June 13th until 5 p. m. for 17,000 sq. yds. brick, asphalt, bitulithic or other pavement; 3,000 lin. ft. concrete curb and gutter and 1,000 sq. yds. of sidewalk construction. c. c. $2,000. J. W. Turnage, Mayor.

Fort Dodge, Iowa—Until June 7th, for 25,000 sq. yds. bitulithic, sheet asphalt, and asphaltic concrete pavement, and 30,000 ft. combined curb and gutter. C. H. Reynolds, City Engr.

Fowler, Ind.—June 5th until 1 p. m., for constructing Kretzemeier Road and Gress Road. Estimated cost $21,582.00 and $4,900. Warren Mankey, Aud. Benton Co.

Gate City, Pa.—Until June 5th, for road improvements to cost about $43,000. J. S. Richmond, County Clerk.

Goldendale, Wash.—June 5th until 10 a. m., for grading and graveling about 3 miles of Permanent Highway No. 5. $17,000 appropriated. Lyman W. Ward, County Engr.

Goshen, Ind.—June 6th until 1:30 p. m., for grading, draining and paving with brick or other road material Ft. Wayne Road, in Jackson Twp., Elkhart County. A. R. Bemenderfer, County Aud.

Indianapolis, Ind.—June 25th until 10 a. m., for reconstructing R. A. Wells Road in Franklin Twp. and Ivan Dougherty Road in same Twp. Leo K. Fesler, County Aud.

Johnson City, Tenn.—June 6th until 7:30 p. m., for street paving with asphalt, cement, asphaltic concrete or tarvia in Imp. Dists. Nos. 20, 21 and 23. About 13,662 yds. paving, 11,226 lin. ft. curb and gutter, 3,850 lin. ft. 6-in. sewer connections, 1,500 lin. ft. 8-in. vitr. sewer, 1,100 lin. ft. 12-in. sewer. c. c. 10% of bid. P. F. McDonald, City Engr.

Kokomo, Ind.—June 6th until 10 a. m., for Weldon Alley Road, Taylor Twp., stone, length 5,300 ft.; for C. M. Ricketts Road, Center Twp., waterbound macadam, length 7,730 ft.; and for Dan Brown Road, Center Twp., asphaltic concrete, length 8,624 ft. Wm. L. Benson, Aud. Howard County.

Mt. Vernon, Ind.—July 5th until 2 p. m., for 1,800 ft. rock road on line between Posey and Vanderburgh Counties. Joseph R. Haines, Aud. Posey County.

North Arlington, N. J.—June 6th until 8 p. m., for sidewalk construction on Kearney Ave. c. c. 5% of bid. John H. Shields, Boro Clerk.

Port Jervis, N. Y.—June 5th until 8 p. m. for about 5,500 sq. yds. brick paving on East Main St. c. c. $500. John F. Cleary, City Clerk.

San Jose, Cal.—Until June 5th, for about 14 miles of county highway construction. Material—asphaltic concrete on 4-in. concrete foundation. Probable cost $200,000. Irving L. Ryder, County Surveyor.

Vincennes, Ind.—Until June 6th, for 75,-136 sq. yds. of paving and grading on Erving, Simpson and Contwell concrete roads. Estimated cost $130,000. W. H. Reel, Engr., Knox County.

CONTRACTS AWARDED.

Albany, N. Y.—To Alfred H. Flinn, Albany, tar surfacing of 33.89 miles of Madison County highways. Bid $10,859.70.

Astoria, Ore.—To The Western Paving Co., 1053 Empire Bldg., Seattle, Wash., bitulithic pavement at $14,000.

Baltimore, Md.—To Baltimore Asphalt Block & Tile Co., Baltimore, sheet asphalt pavement on five streets in Northwest Baltimore, at $53,647.50.

Battle Creek, Mich.—To The Globe Constr. Co., Kalamazoo, contract to lay 50,000 sq. yds. asphaltic concrete pavement.

Bellingham, Wash.—To K. Sauset, concrete curbs, gutters, and sewers on Ellis St., at $15,256.

Bloomington, Ind.—To Joseph H. Campbell, City, two-course concrete pavement on S. Walnut St. at $15,755.

Brazil, Ind.—To The Carpenter Constr. Co., Brazil, monolithic brick pavement on Kester Road in Brazil Twp., at $85,400.

Canton, Ohio—To The Cleveland Trinidad Paving Co., Cleveland, asphalt pavement on 14th St. N. W. at $10,275. To Wise Bros. city, Metropolitan paving block on Brown Ave. at $28,625. To F. A. Downs Constr. Co., Metropolitan paving block on 8th St. at $35,623; on Gibbs Ave. at $29,597, and on 9th St. at $25,825.

Connersville, Ind.—To Conner & Sherry, Connersville, concrete pavement on Grand Ave., 17th to 21st Sts. at $1.39.

Columbia, S. C.—To Atlantic Bitulithic Co., Richmond, Va., 17,000 sq. yds. paving at $1.96 per sq. yd.

Dallas, Tex.—To Standard Engineering Co., paving of Lucile St. at $11,646.15.

Dundee, Ill.—To John Kappen, concrete pavement in Dundee Twp. at $2,350.

Elizabethtown, Ky.—To Fletcher & Peak, three miles road construction on Dixie Highway in Hardin County at $1.45 per yd.

Harrisburg, Ill.—To Chas. H. Degenhardt, Alton, Ill., paving of Jackson St. at $112,-112.57. Cement sidewalk construction awarded C. M. Hanes, Jerseyville, Ill. at $45,300.60.

Lowville, N. Y.—To Pathfinder Constr. Co., Fulton, N. Y., surface treatment of State Highways leading through Lewis County at $5,482.90.

Milwaukee, Wis.—To Gumz, Gutknecht & Wussow, Milwaukee, pavement on St. Martin's road No. 2, and on Loomis Road No. 3 at $45,960.

Missoula, Mont.—To J. C. Maguire, Butte, Mont., bitulithic pavement on 4-in. concrete base on East Front St., at about $22,000.

Monroe, Mich.—To Garrigan Bros. Co., Toledo, O., 9.66 mi. water bound macadam on Stewart Road, at $98,000; to same firm, 6.83 mi. same type pavement on Palmer Road, at $73,000. To Edgington & Robbins, Arlington, O., 6 mi. same type pavement on Maybee Road, at $64,700.

Moscow, Ida.—To Standard Asphalt Paving Co., contract for improving three districts at $34,553.

New Albany, Ind.—To Staebler & Gregg, macadam pavement on Center St. at $2.93 per ft. and for vitr. brick pavement on Oak St. at $4.15 per ft.

North Platte, Nebr.—To G. V. Stack, Denver, Colo., about 45,000 sq. yds. vert. fibre brick pavement in business district at approximately $104,000.

Pasco, Wash.—To W. A. Morain, Kennewick, Wash., construction of Permanent Highway No. 4 at $17,000.

Patchogue, N. Y.—To Gifford Constr. Co., Jamaica, N. Y., concrete pavement on Ocean Ave. from Division St. to Day, at $19,770.

Peru, Ill.—To Trompeter & Sons, La Salle, Ill., paving of 3rd St. at about $23,-000 and of 7th St. at $30,000.

Piqua, Ohio—To Hinkle & Sullivan, Cincinnati, Ohio, 21,000 sq. yds. bitulithic pavement on Broadway at $2.15 per sq. yd.

Pittsburg, Camp Co., Tex.—To vibrolithic Co., Dallas, Tex., paving of Main St. and intersecting streets.

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Contracting News

Pontiac, Ill.—To It. Lobb & Son, Pontiac, paving of Reynolds St. at $16,600.

Rock Island, Ill.—To The McCarthy Improvement Co., asphalt pavement 24-ft. wide, with concrete curb and gutter on 39th St. at $1.85 per sq. yd. for paving, 64 cents per ft. for curb and gutter and 40 cents for excavation.

Schenectady, N. Y.—To Brown & Lowe, Schenectady, resurfacing Amsterdam road from Montgomery County line to Scotia with asphalt $27,749.10.

Troy, Ohio—To Hennessey Bros., Troy, Metropolitan brick pavement on East Main St., at $39,912.70.

Vincennes, Ind.—To Premier Constr. Co., Indianapolis, Ind., asphalt pavement on Church St. at $1.81 per sq. yd.

CONTEMPLATED WORK.

Atlantic City, N. J.—County officials have called for survey and estimates on cost of 16-ft. wide highway along White Horse Pike, connecting Camden County 14-ft wide paved road. Estimated cost $450,000. Work will probably be completed by fall. Address County Commrs., Atlantic County.

Bakersfield, Cal.—Plans being prepared for paving 17th St., length about 2 miles. Estimated cost $100,000. Bids will probably be taken about Aug. 1st. Plans will also be prepared for grading, tamping and oiling streets in East Bakersfield, Mr. Ray, City Engr.

Blackfoot, Ida.—Hard surfacing of 20,000 sq. yds. of streets to cost about $22,000 authorized by City Council.

East St. Louis, Ill.—Plans completed for paving 23rd st. with brick, about 12,225 sq. yds. and for resurfacing Missouri Ave. with brick, about 62,660 sq. yds. Fred W. Mollman, Mayor.

Lima, Ohio—Bids will be received soon for paving Jefferson St. and Bellefontaine Ave. Estimated cost, $17,596 and $22,422. C. Bryson, City Engr.

Liberty, Mo.—Bond issue of $1,250,000 will be voted on June 24th for building about 200 miles of rock roads in Clay County. Address County Commrs.

Taft, Cal.—Estimates are being secured for paving Center, 4th, Main and 6th Sts. Bond issue of $40,000 contemplated for this work. Fay Curtis, City Clerk.

SEWERS.

BIDS REQUESTED.

Afton, Okla.—June 14th until 8 p. m., for constructing system of main and lateral sewers. Approximate cost of mains, $17,000; of laterals, $13,500. The Benham Engr. Co., Consult. Engrs., Oklahoma City, Okla.

Clinton, Iowa—June 13th until 8 p. m., for sewer construction in 16th Ave., about 860 lin. ft. 10-in. vitr. sewer pipe required. Address City Clerk.

Harlowton, Mont.—June 15th until 8 p. m., for furnishing material, labor and machinery for installation of complete sewer system and Imhoff Disposal Plant. Fred W. Barron, Mayor. Geo. E. Baker, Consult. Engr., Whitehall, Mont.

Montclair, N. J.—June 12th until 8 p. m., for about 980 lin. ft. of 39-in. storm sewers of reinforced concrete pipe with wye branches of vitrified pipe.

Wilton, Conn.—June 6th until 7:30 p. m., for 10,000 lin. ft. of 8-in. to 18-in. vitr. tile sewers. c. c. $500. Homer R. Turner, Civil Engr., Windsor, Conn.

CONTEMPLATED WORK.

Butte, Mont.—Installation of storm sewers to serve all sections of city being considered. J. J. Armstrong, Comr. of Pub. Wks.

Corsicana, Tex.—Contract will be let this summer for about $100,000 worth of sewer improvements and disposal plant, an additional $10,000 including sludge beds, etc. J. L. Hallbert, Mayor.

Fargo, N. D.—Plans will be prepared at once for new scheme of trunk sewerage for south side. H. F. Emery, Mayor.

Ft. Madison, Iowa—Plans being prepared for sanitary sewer system by Burns & McDonnell, Engrs., Kansas City, Mo. City contemplates 15 miles of sewers. G. P. Anthes, City Clerk.

Hagerstown, Md.—Details are now being worked out for installation of sewerage system. Bond issue $750,000. J. McPherson Scott, mayor.

Indianapolis, Ind.—Plans being prepared for sewer in Tremont Ave. Estimated cost $20,000. B. J. T. Jeup, city engr.

Kearney, Nebr.—Plans for storm sewer accepted by city council. E. H. Morey, city engr.

McComb City, Miss.—Bonds to the amount of $90,000 for installing sewerage system will be sold June 20, at which time contract for work will be awarded.

Nappannee, Ind.—Plans being made for sanitary sewer system for town.

Mount Pleasant, Mich.—Bond issue of $42,000 for constructing new main trunk sewer will be voted on May 29.

Oxford Junction, Iowa.—Installation of sewer system planned. Bids will be asked shortly. Address city council.

San Francisco, Cal.—Construction of concrete sewer on Sloat Blvd. at cost of $21,000 authorized. Address bd. of pub. works.

Traer, Iowa.—Sewer extensions to cost $4,000 voted. Work to be started after July 1.

Tyler, Tex.—Plans being prepared for improvements to sewer system recently purchased by city. Bartlett & Ranney, engr., San Antonio, Tex.

Wichita, Kans.—Construction of sanitary sewer system for northwest Wichita is being considered. Probable cost $200,000. O. H. Bentley, mayor.

SEWAGE DISPOSAL PLANTS.

CONTEMPLATED WORK.

Buffalo, N. Y.—Tentative plans have been given officials of all municipalities on both sides of Niagara River interested in construction of sewage disposal plants to prevent pollution of boundary streams by International Joint Waterways Comm. Estimated cost of system for this city $3,600,000; for Niagara Falls, two plants, $788,500; for Niagara Falls, Ont., $83,000, and for La Salle, $40,000. Public hearing will be held June 21 in Buffalo by comm.

WATER WORKS.

BIDS REQUESTED.

Chicago, Ill.—June 7, until 11 a. m., for one motor driven centrifugal pump and all auxiliaries for Rogers Park Pumping Station. c. c. $100. W. R. Morhouse, commr. of pub. works.

Decatur, Ind.—June 6, until 7 p. m., for installation of 300 or 500 k. w. Turbo generator. H. M. DeVoss, city clerk.

Harlowton, Mont.—June 15, until 8 p. m., for furnishing labor, material, machinery, etc., for complete water works system. Work includes motor or gasoline engine or both, pump, steel tower and tank, fire hydrants, gates, water pipe, pump station and equipment. c. c. $300, or c. c. 3 per cent. of bid, but not less than $300. Geo. E. Baker, consult. engr., Whitehall, Mont. Fred W. Barron, mayor.

Monticello, Ind.—June 3, until 7:30 p. m., for extensions of water mains. F. R. Fisher, city clerk.

Oatman, Ariz.—Until June 15, for installation of water and sewer systems. Probable cost $250,000. C. L. Mayhem, secy. Mojave-Oatman Water Co.

Port Arthur, Tex.—June 15, until 2 p. m., for installing equipment for pumping plant. c. c. 5 per cent. of bid. R. H. Dunn, mayor.

CONTRACTS AWARDED.

Commerce, Okla.—To N. S. Sherman Machine & Iron Works, Oklahoma City, construction of distributing system of cast iron water mains, pumping station and reinforced concrete reservoir at $17,849.40, to Worthington Pump & Machinery Corp., Kansas City, Mo., complete air lift equipment, duplex power pumps, motors, piping and electrical equipment, at $6,235.00; to Ludlow Valve Mfg. Co., fire hydrants and valves, at $1,164.50; to Chicago Bridge & Iron Works, Chicago, 75,000-gal. elevated tank and tower, at $5,700.00.

Three Forks, Mont.—To Security Bridge Co., Spokane, Wash., installation of water works system, at $76,851. About 7 miles of Matheson joint pipe required. Swearingen & McCulloh, engr., Seattle.

CONTEMPLATED WORK.

Bakersfield, Cal.—Plans being prepared for pump and motor to be installed at Myrtle Sewage Pumping Station. Robt. E. Ray, city engr.

Bruce, S. D.—Construction of municipal water works system being urged by business men.

Miller, Nebr.—Bond issue of $10,000 voted recently for water works system.

Northport, Wash.—Installation of water works system to cost $25,000 is being considered. Guy V. McClure, city engr.

Plattsburg, Mo.—Plans being prepared for water works system. Estimated cost $35,000. E. B. Murray, city engr., 920 Walnut St., Kansas City.

Poughkeepsie, N. Y.—Bond issue of $240,000 for water works extensions will be voted on May 25. Daniel W. Wilbur, mayor.

Salisbury, N. C.—Plans being prepared for water system for Salisbury Water Works Co. Estimated cost $125,000. J. L. Ludlow, engr., Winston-Salem.

Slater, Mo.—Bond issue of $35,000 voted for improving water system and electric light plant. C. E. Shepherd, city engr.

Tarboro, N. C.—City contemplates $30,000 bond issue for improving water system and electric light plant.

MISCELLANEOUS.

BIDS REQUESTED.

Caldwell, Ida.—Until June 5, for tile flusher and tile sprinkler, bids to be accompanied with plans and specifications. Address city clerk.

Greendale, Ind.—June 6, until 7:30 p. m., for 10,000 gals. road oil. F. J. Abraham, town clerk.

Greenville, Ohio.—June 3, until 10 a. m., for dredging a part of Stillwater Creek, length 7.97 miles. Estimated cost $33,663. Harry C. Miller, county surveyor.

Hackensack, N. J.—June 5, until 11 a. m., for following machinery: sand distributing wagon, reversible road grader, heavy type, street sweeper, asphalt kettle with stone dryer, scarifier, platform spring gear sprinkling wagon, two dump carts, 500-gal. gasoline tank. James M. Harkness, clerk bd. of Chosen Freeholders of Bergen co.

Hanford, Cal.—June 5, until 10:30 a. m., for one traction engine or caterpillar with at least 22 h. p. drawbar pull. E. F. Pickerill, county clerk.

Hanford, Cal.—June 5, until 10:45 a. m., for one M. Haynes universal road machine. E. F. Pickerill, county clerk.

Ray, Ariz.—June 10, until noon, for constructing steel sheet pile bulkhead and reinforced concrete retaining wall. c. c. $3,500. Address L. C. Cotes, gen. mgr. of Ray Consolidated Copper Co.

Seattle, Wash.—June 7, until 1:30 p. m., for locomotive crane for Central Waterfront Improvement of Port of Seattle. c. c. 5 per cent. of bid. C. E. Remsberg, secy. of Port Commission.

CONTEMPLATED PURCHASES.

Ann Arbor, Mich.—Net prices on street flushers for cleaning paved streets are desired by city. Manley Osgood, city engr.

Grand Rapids, Mich.—Bond issue of $500,000 for complete flood protection work is being considered. Nothing definite has been done. Robt. Moore, city engr.